T-2420

PRECISION TEMPERATURE FORCING SYSTEM

MAINTENANCE MANUAL

THERMONICS

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PRECISION TEMPERATURE FORCING SYSTEM

MAINTENANCE MANUAL

Thermonics Incorporated
3350 Scott Blvd., Bldg. 32
Santa Clara, CA 95054-3118
Phone: (408) 496-6838
Telex: 172-353
Fax: (408) 496-6918

6/17/87 rel.

Warranty

Thermonics warrants their equipment, when installed, operated and maintained in accordance with the operating and maintenance specifications included with the equipment, against defects in material and workmanship for a period of twelve (12) months in accordance with the following:

a) For a period of twelve (12) months from date of original shipment Thermonics will repair, replace or otherwise perform warranty service consisting of parts and labor on defective assemblies or components, without charge. Transportation to be prepaid by purchaser. For on-site repair, charges will be based on travel expenses only.

b) Thermonics shall not be responsible for defects caused by accident, misuse, neglect, alteration, or improper installation.

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GENERAL INFORMATION

INTRODUCTION

This manual contains information for use in preventive maintenance, trouble shooting and corrective maintenance. The information is intended to aid the service technician to identify, locate and repair the malfunction to the board level. *This manual supplements the T-2420 Precision Temperature Forcing System Users Manual.*

SCOPE OF MANUAL

This manual is primarily directed to service personnel knowledgeable in the repair of electronic and mechanical equipment. The manual consists of four sections, as follows:

General Information

This section provides introductory information to include a brief description of the T-2420 and an examination of the various services offered by Thermonics.

Functional Theory of Operation

This section describes the operation of the PTFS assembly, the Air Dryer assembly and the Control Electronics.

Maintenance

Preventive Maintenance - This sub-section provides detailed information for cleaning and visually inspecting the equipment.

Trouble Shooting - This sub-section provides information to assist in the isolation of a fault.

Corrective Maintenance - This sub-section provides information for obtaining replacement parts, component removal, replacement and recalibration.

Calibration

This section covers the techniques and procedures needed to calibrate the system. The manual and automatic calibration methods are covered.

Assembly Drawings and Parts Lists

This section lists field replacement part numbers along with the corresponding assembly drawings showing location of the parts.

SPECIFICATIONS

Physical Characteristics

Size:	21 inch wide X 24 inch deep X 50 inch high
Weight:	250 pounds

Environment

Temperature Range:	$20^{o}C$ to $27^{o}C$ (operating)
	$-40^{o}C$ to $80^{o}C$ (non-operating)
Relative Humidity:	0% to 60% (operating)

Power Requirements

208VAC to 220VAC, single-phase, 50/60 HZ at 15A
Typical Power Consumption = 13A
Compressor Startup Surge Current = 47 Amps for 100ms

Compressed Air Input Requirements

Pressure:	80 PSI (552 kPa) to 100 PSI (689 kPa)
Flow Rate:	600 SCFH (10 SCFM) (719 ml/s) (.00471 m^3/s)
Dew Points:	$10^{o}C$ at 80 PSI ($-80^{o}C$ with internal air dryer bypassed)
Quality:	Free of oil, particulate matter, and excessive water. (oil vapor 40 PPM max with internal air dryer bypassed)

Performance

Temperature Range:	Hot: $30^{o}C$ to $200^{o}C$
	Cold: $-70^{o}C$ to $30^{o}C$

Temperature Accuracy:	$\pm$1.0^{O}C (-70^{O}C to +125^{O}C) $\pm$1.5^{O}C (+125^{O}C to +200^{O}C)
Temperature Stability:	$\pm$1.0^{O}C
Temperature Repeatability:	$\pm$0.5^{O}C
Gas Flow Range:	200 SCFH to 600 SCFH (temperature and fixture dependant)
Remote Interface:	RS-232C Serial Interface IEEE-488 Parallel Bus ATE Parallel Connection (for Start-Test and End-of Test signaling)

DESCRIPTION

The T-2420 PTFS consist of three primary units, the Refrigeration unit, the PTFS Control Box and the Air Dryer. The system may also include the optional movable arm assembly.

PTFS Control Unit - is mounted atop the refrigeration unit and contains the air heaters, solenoids and electronics for control of the Hot and Cold gas flow. Front panel mounted push-buttons and a fluorescent Alpha-Numeric Display coupled with two flow regulators, enable the operator to setup and program a series of temperatures and air flows.

In addition, a purge circuit provides warm gas to the fixturing to prevent the formation of ice.

Refrigeration Unit - is mounted to the chassis floor and chills the incoming air to the PTFS Control Box to temperatures below -80^{o}C. The unit uses a single-stage compressor and contains built in protective devices to insure reliable operation.

Air Dryer - mounted within the chassis, directly behind the refrigeration unit, removes moisture, oil and other contamination from the air supply and produces a dew point less than -80^{o}C. The dryer is a heatless regenerative type requiring only an air source to operate.

Movable Arm and Thermal Test Head (optional) - consists of a multijointed arm with pneumatic assist and test fixture attached. The arm can easily be positioned to various lengths, heights and angles for reaching different ATE test head configurations. For quicker response, the movable arm can be fitted with the LN_2 injection option. Units ordered without the movable arm option, cannot be retrofitted.

THERMONICS SERVICE

Training

Formal technical training is conducted at the Thermonics facility in Santa Clara on a scheduled basis. Two credits for training are provided with the purchases of each system. Training of additional personnel or on-

site training can be provided at a modest cost. The course covers the theory of operation and the maintenance of the T-2420 PTFS. Further information can be obtained from Thermonics Customer Service.

Repair Service

Thermonics maintains a fully equipped repair center in Santa Clara, which provides warranty and non-warranty repairs and emergency spares support. For further information on repairs and spare parts availability contact Thermonics Customer Service.

Before returning the system or parts for repair, contact Thermonics Customer Service to obtain a RMA number.

Spare Parts

All electrical and mechanical part replacements for the T-2420 can be obtained directly from Thermonics Inc.

Refer to the *Maintenance* section and subsection *Obtaining Replacement Parts.*

Technical Support

Questions of a technical nature regarding this manual or the T-2420 should be directed to:

Thermonics Inc.
3350 Scott Blvd., Bldg. 32
Santa Clara, CA 95054-3118
Phone No.: (408) 496-6838
Telex No.: 172-353
Fax No.: (408) 496-6918

USER REPAIR

Introduction

Thermonics will aid in the repair and/or replacement of all components, assemblies, sub-assemblies etc., as stated in the warranty.

The CPU and I/O PC boards are not user repairable, and must be exchanged. A nominal charge for the boards is required after the warranty has expired.

Updated ROM(s) will be supplied during the warranty period at no cost and a nominal cost after the warranty has expired.

FUNCTIONAL THEORY OF OPERATION

INTRODUCTION

This section describes the general operation of the hot and cold flow paths, the control electronics, the air dryer and the mechanical refrigeration unit. Figure 1 shows the T-2420 system block diagram.

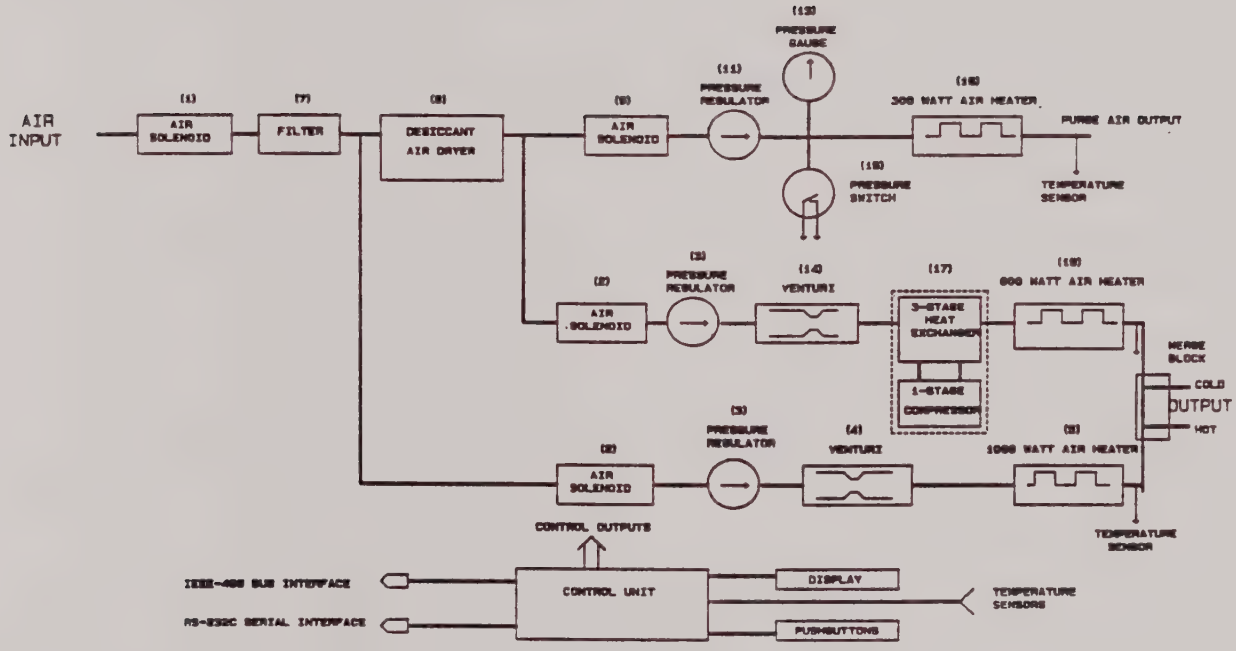

Figure 1.

T-2420 Block Diagram

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Functional Overview

When the power switch is first turned on, the system will automatically self test the internal ROM, RAM, thermostats, sensors AC switches and other components affecting the operation of the unit. During the test, a series of messages will be displayed to indicate the status of the equipment as follows:

T2420 Version X.X
Checking Memory
Line Freq. XX Hz
Testing IO Board

If an error is detected, the appropriate error message will be displayed, otherwise the system enters the stand-by mode. The **AMBIENT** lamp illuminates.

The incoming Air Solenoid (1) energizes and connects the air source to the desiccant air dryer and filters. The air dryer begins to function and produces an audible sound of rushing air. See paragraph *Air Dryer Description* for further information. See figure 1.

Pressing the **HOT** push-button causes Air Solenoid (2) to energize producing air flow through the Pressure Regulator (3), the Venturi (4), the 1000 Watt Air Heater (5) and out the lower path of the Gas Merge Block (6).

The pressure regulator is used to adjust the air flow. The venturi is a machined block with two orifaces that creates a differential pressure proportional to the air flow. A differential pressure transducer connected to the venturi with two 1/8-inch polyurethane tubes converts the differential pressure to a DC voltage proportional to the air flow. The pressure transducer is located on the Flow Control Board (control unit).

The 1000 watt air raises the air temperature to the desired temperature. The air heater is controlled with a zero cross-over AC switch located on the Heater Control Board. The AC switch and heater is continually monitored by the CPU for an open or shorted condition. Attached to the heater is a bi-metal thermostat for detecting excessive heater case temperature. If an over temperature condition is detected, the power to the air heaters is switched off and the appropriate error message is displayed. Mounted at the air heater output is a Type-K thermocouple for monitoring the air temperature for precise control of the air temperature.

For systems fitted with the movable arm option, the hot and cold air heaters are remoted to the Head Assembly. The heaters in the control box are removed and bypassed.

The Gas Merge Block (6) combines the gas outputs from both the hot and cold air heaters. Either port may be used for connecting to a thermal fixture; however the lower port runs approximately 2 to 3°C colder and is suggested for cold temperature operation.

When configured with the movable arm option, the upper port is capped and the lower port in connected to the cold line from the arm. The hot line from the arm is connected to a third fitting above the capped port on the rear panel, labeled **AMBIENT AIR**.

Momentarily pressing the **COLD** push-button, causes Air Solenoid (2) to de-energize and stops the air flow through the hot path. Solenoids (10) (cold air) and (9) (purge air) energize switching the air flow to the purge and cold air paths on.

The Pressure Regulator (12), Venturi (14) and 600 Watt Air Heater (18) function the same as those components described in the hot air circuit.

Prior to entering the cold circuit, the air first passes through the desiccant Air Dryer. The air is filtered and all moisture and oil is removed to produce a dew point greater than -80°C. See *Air Dryer* description for a functional description.

The air is then passed through the single stage Refrigeration Unit (17) to chill the air to -85°C. See *Mechanical Refrigeration Unit* for a functional overview.

The purge path (top path) functions when the cold path is selected. Solenoid (9) automatically switches on when (10) is switched on.

The purge Pressure Regulator (11) is mounted on the rear panel and is used to regulate purge air flow. The purge gauge (13), located next to the pressure regulator, displays the purge pressure.

The 300 Watt Purge Heater raises the temperature of the purge air to the desired temperature. A Type-K thermocouple mounted at the heater output is used to sense and control the temperature. To protect the

heater, a Pressure Switch (15) at the input prevents it from being powered if the air source is turned off. A thermostat mounted to the heater case protects the heater from a high temperature situation.

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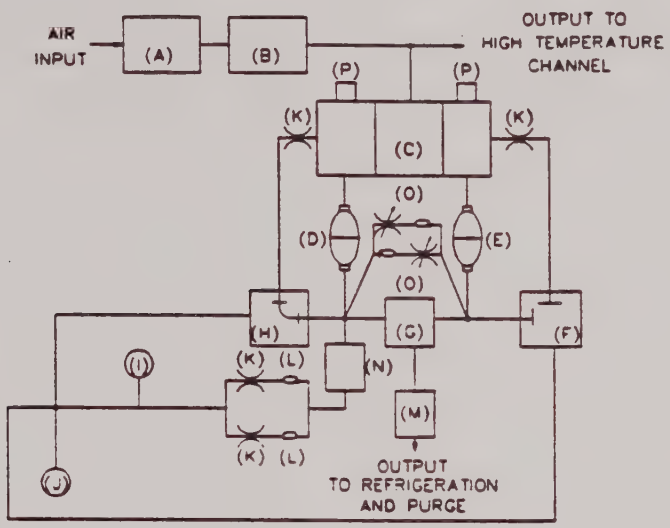
Air Dryer Block Diagram



A) WATER SEPARATOR/FILTER

B) COALESCING FILTER

C) 4-WAY, 3-POSITION PILOT SPOOL VALVE

D) DESICCANT TANK

E) DESICCANT TANK

F) 2-WAY PILOT VALVE, NORMALLY OPEN

G) 3-WAY, 2-POSITION PILOT SHUTTLE VALVE

H) 2-WAY PILOT VALVE, NORMALLY CLOSED

I) PRESSURE GAUGE (0-100 PSI)

J) AIR VOLUME TANK (PNEUMATIC TIMER)

K) AIRFLOW RESTRICTOR

L) CHECK VALVE

M) PARTICLE FILTER

N) DUST FILTER

O) ADJ. RESTRICTOR & CHECK VALVE

P) MUFFLER

Figure 2.

Air Dryer Block Diagram

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Air Dryer Description

The air first passes through filters (A) and (B) to remove excessive amounts of oil and moisture. The filtered air is directed to both the PTFS hot circuit and Air Dryer Spool Valve (C). See figure 2.

The air passes through the spool valve (left side) to Desiccant Tank (D), through Spool Valve (G), through Dust Filter (M) and to the PTFS refrigeration circuit. A small amount of dry purge passes through variable restrictor and Check Valve (O) into Desiccant Tank (E) to remove moisture from the desiccant accumulated during the previous cycle. The moisure laiden air then exhausts out Spool Valve (right-side) and muffler (P).

The Tank (J) pressure slowly builds to approximately 55 PSI (displayed on pressure gauge (I)) and causes Spool Valve (H) to open and Spool Valve (F) to close. Desiccant Reservoir (D) output pressure drops to approximately 5 PSI and causes Air Volume Tank (I) to suddenly discharges its air pressure. The air now flows in the direction through reverse Desiccant Reservoir (D), into Spool Valve (C) and exhausts out Muffler (P). The exhause flow is restricted by Restrictor (K) and Check Valve (L) to allow adequate time for Desiccant Reservoir (D) to be purged of any moisture accumulated during the previous cycle.

A limited amount of air passes through Restrictor (K) and Check Valve (L) into Volume Tank (J).

After approximately 30 seconds and when the tank pressure drop to 5-10 PSI, Spool Valve (H) closes and Spool Valve (F) opens.

MOVABLE ARM AND TEST HEAD (OPTIONAL)

Description

The movable arm assembly attaches to the Base Pivot Plate located on the rear side of the T-2420 PTFS. See assembly drawing 3F-100-1A in section *Assembly Drawings and Parts Lists.*
The overall assembly consists of 6 basic subassemblies as follows:

Rear Pivot Assembly (3F-102-1A) - houses the bearing and support assemblies for horizontal motion of the arm.

Rear Pivot Brake Assembly (3F-101-1A) - houses the braking and brake handle assemblies for locking horizontal motion of the arm. See figure 4.

Elbow and Brake Assembly (3F-103-1A) - houses the up/down and left/right joints for forward arm positioning. A pneumatic assist cylinder is attached to aid up/down movement and locking. A second brake is located in the left/right joint for horizontally locking the mechanism. A manual override is provided at each brake. See figure 5.

Head Bracket and Pivot Assembly (3F-104-1A) - supports the head assembly and enables the assembly to be rotated clockwise or counter-clockwise and pivoted inward or outward. Both joints use a large knurled knob for holding the position. See figure 6.

Two push-buttons mounted on top of the support handle operate the rear pivot brake and elbow brakes. Two buttons mounted on the front of the support handle (recessed) raise and lower the head. See figure 6.

The thermal test head is configured with two hot air heaters and a insulated cold heater. Attached to each air heater case is a thermostat for protecting against an over temperature condition. A diverter valve connected to the cold heater output produces a cold air bleed to keep the circuit chilled. The diverter output and two hot air heater outputs are connected to the purge gas assembly at the output of the test head. See figure 3 for the *Test Head* diagram and drawing 3F-105-1A for the detailed assembly.

Cup Assembly (3F-105-1A) - consists of a pyrex window and mounting hardware, mounted to the bottom of the test head for holding the environment over the DUT.

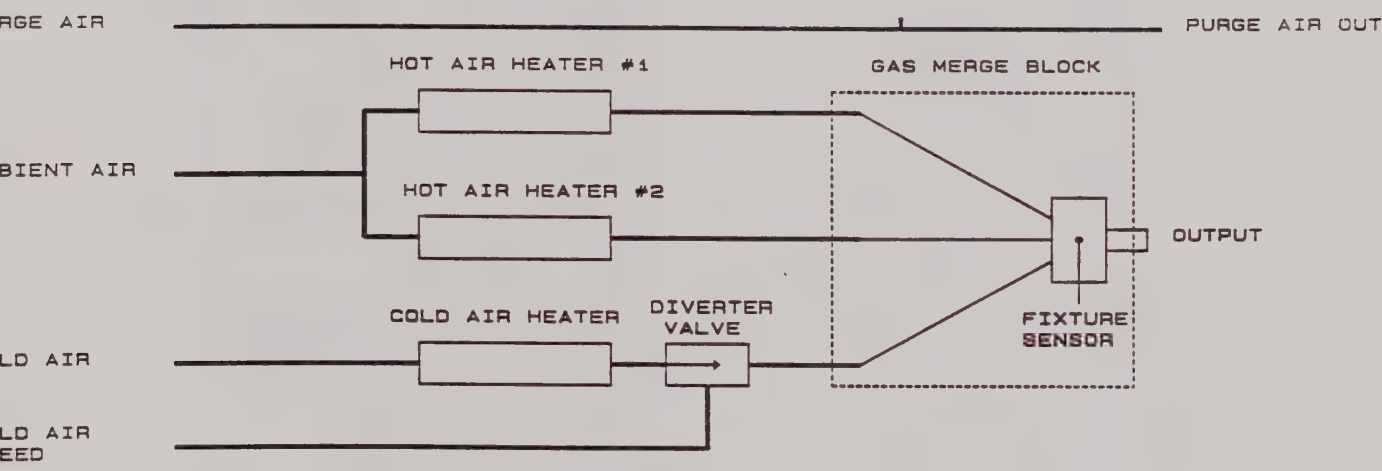

Figure 3.

Block Diagram

Thermal Test Head for Movable Arm

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Figure 4.

Rear Pivot and Brake Assembly

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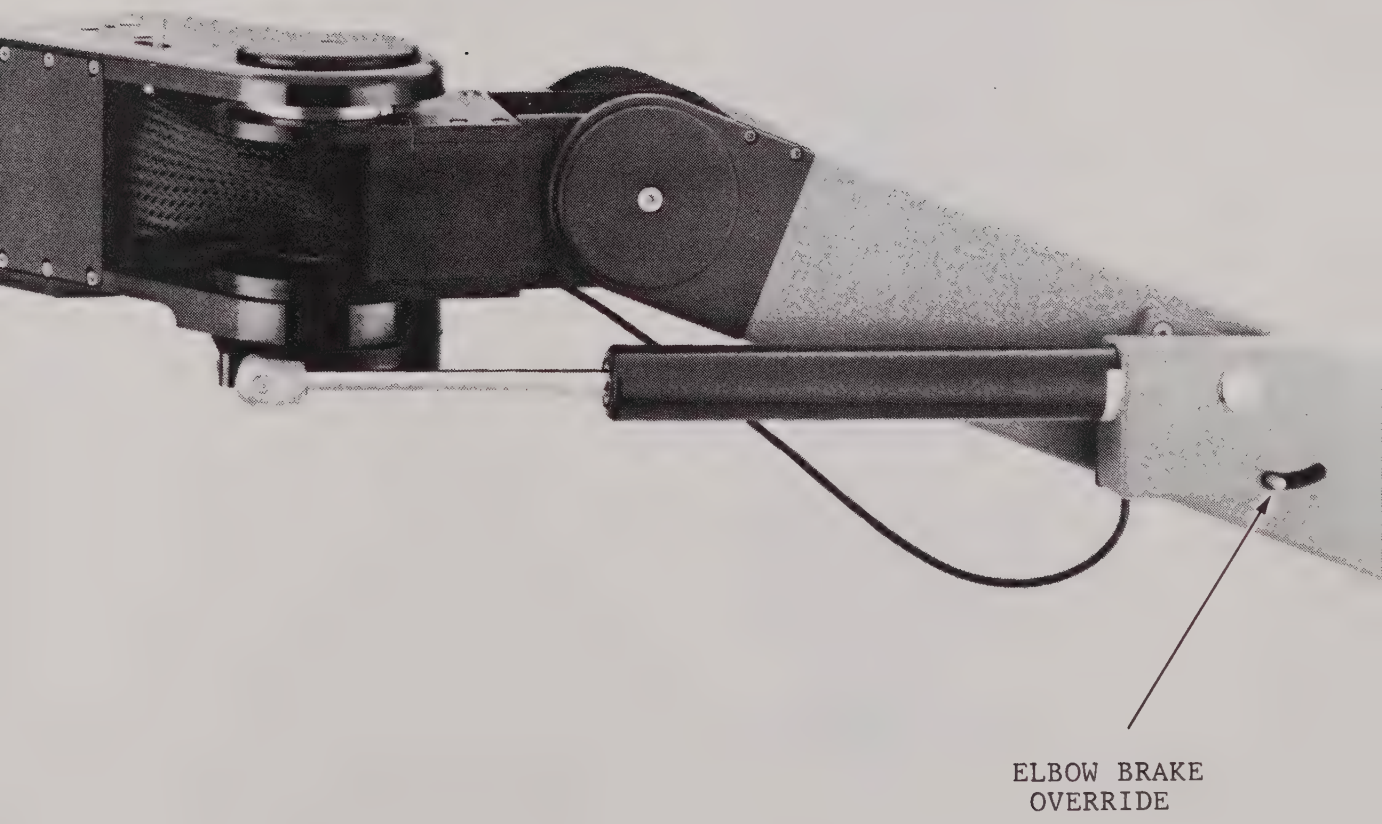

Figure 5.

Elbow and Brake Assembly

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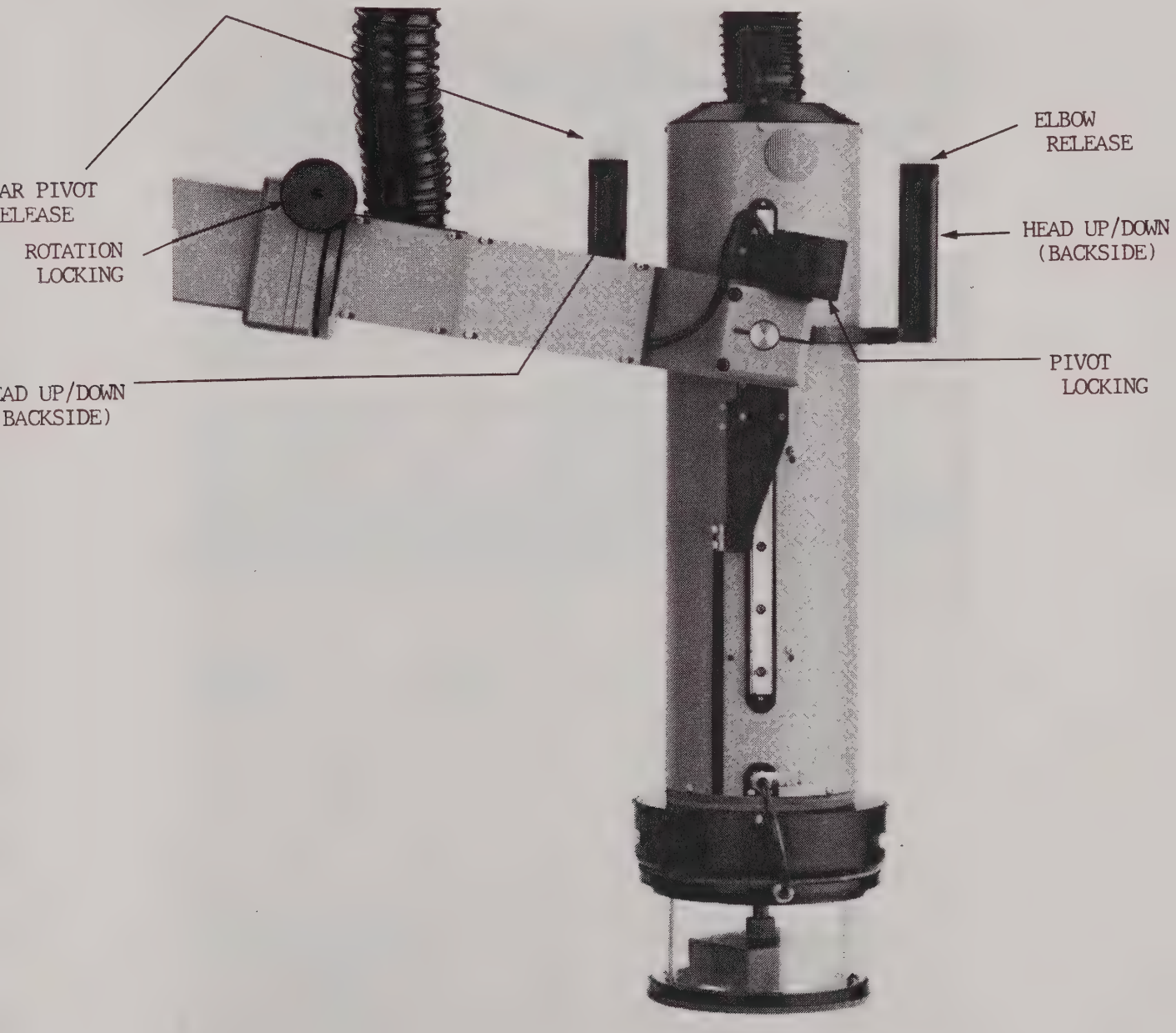

Figure 6.

Head Assembly

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Control Unit Description

The Control Unit consist of the CPU Board, the I/O Board, Flow Control Board, Heater Control Board and Boom Control Board is equipped with the optional movable arm or LN_2 injection. The functional description of each board is as follows (see Figure 7):

CPU Board - Consists of six elements with the following functions.

IEEE-488 Interface - Contains the circuitry for IEEE-488 Bus Interface and management.

Z80 Microprocessor - Central control processor bus management of the Logic Board and other boards attached.

Program and Data Memory - Contains the system program ROM and RAM.

RS-232C Interface - Contains the RS-232C protocol and interface circuitry.

Digital I/O - Interfaces the keyboard push-buttons and Alphanumeric Display to the processor.

System Timer - Establishes different time bases for the processor to access.

I/O Board - Consists of five circuit elements as follows:

Analog/Digital Converter - Converts analog signals from the different transducers and sensors to digital data for processing by the CPU.

Resistance Measurement - Converts the resistance from up to four RTD's to an analog voltage.

Thermocouple Amplifier - Amplifies the low level Type-K thermocouple voltages to usable values for the Analog/Digital Converter.

Digital I/O - Interfaces "On/Off" type closures, such as thermostats, relays and etc. to the processor.

Fail/Safe Circuits - Consists of a series of level comparators for monitoring the thermocouple for an over temperature condition.

Flow Control Board - Consists of three circuit elements for control, monitoring and display of gas flow.

Pressure Sensor Amplifiers - Amplifies the low level output from the differential pressure transducer for use by the Analog/Digital Converter.

Air Valve Control - Contains all AC switches and control for the different air valves.

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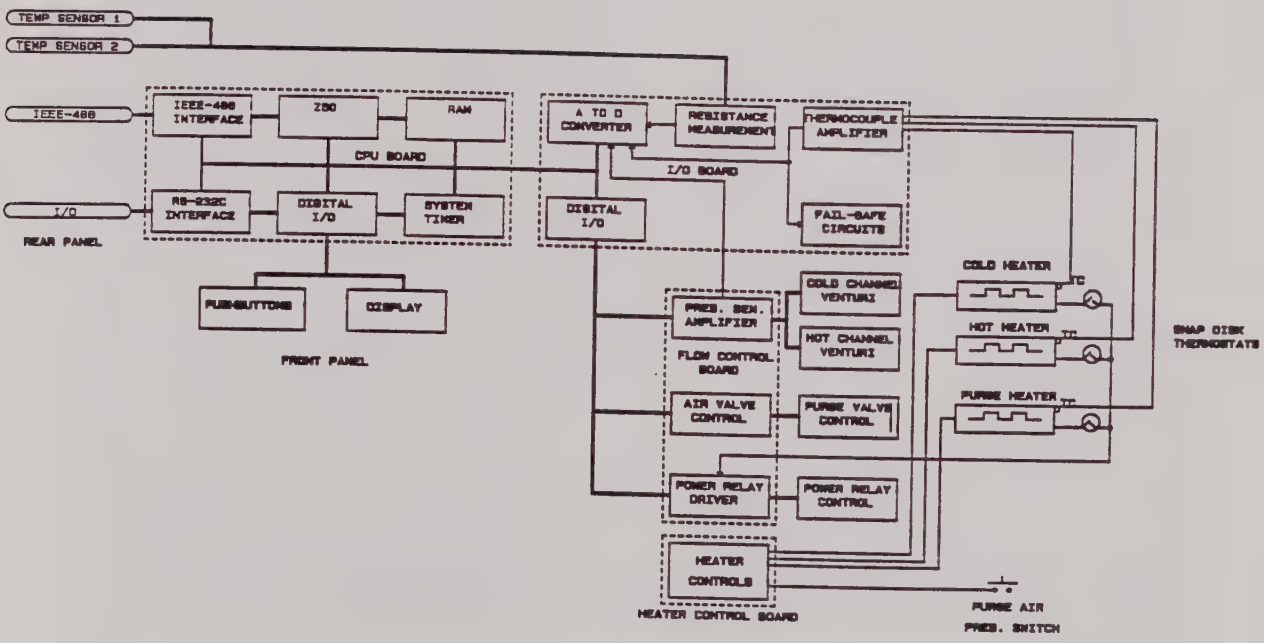

Figure 7.

T-2420 Control Unit Diagram

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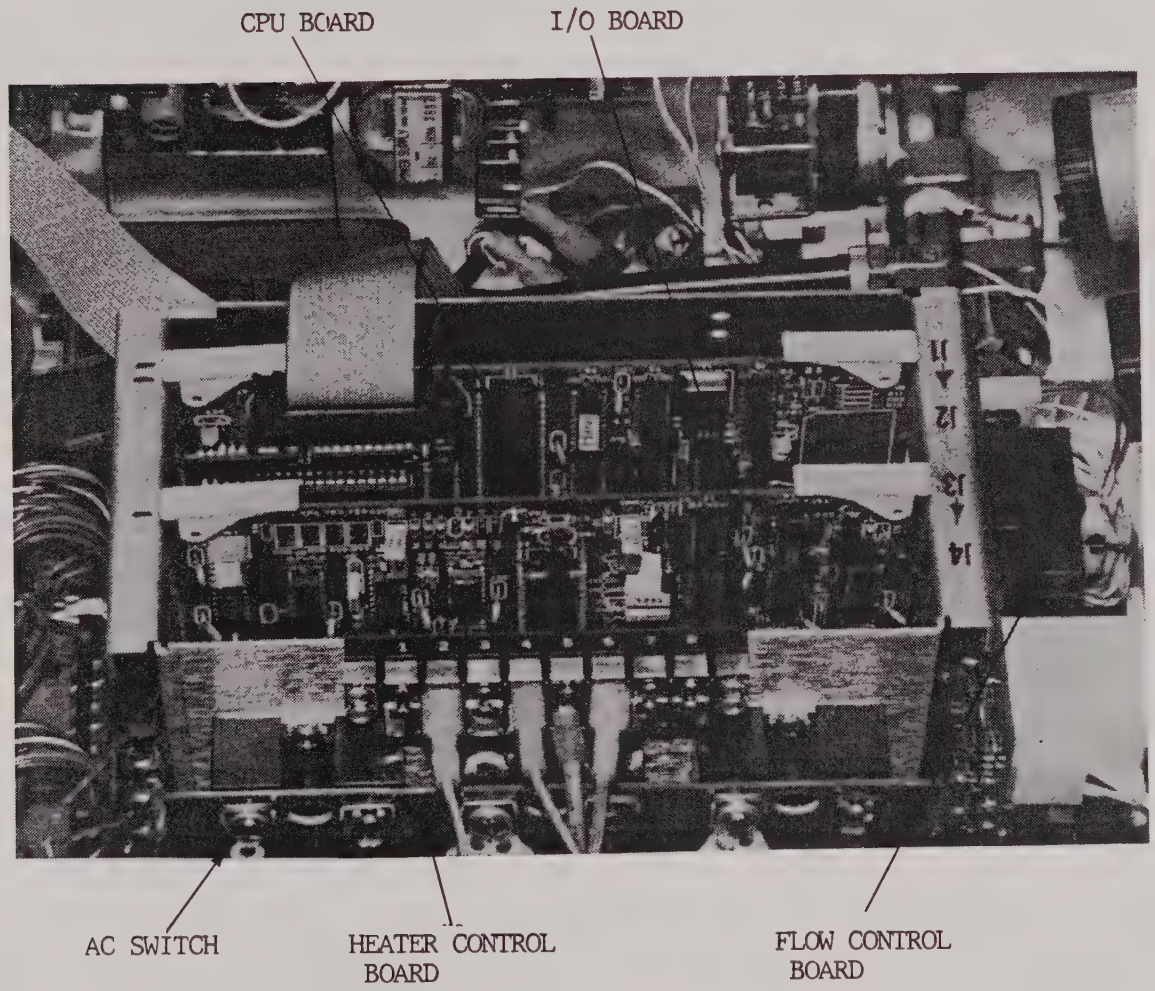

Figure 8.

PC Board Locations

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Power Relay Driver - Contains the control circuitry for switching the Power Relay ON and OFF.

Mechanical Refrigeration Unit

The cooling process is of a self-refrigerating cascade type. A mixture of non-flammable and safe halocarbon ("Freon") refrigerants is compressed and circulated by a compressor. The cycle consists of:

(a) compressing the refrigerant mixture
(b) partially condensing the higher boiling fractions in the air-cooled condenser
(c) withdrawing and throttling the condensate to produce cooling which condenses the remaining vapors in the heat exchanger
(d) throttling and evaporating the condensate in a coil to produce cooling at very low temperatures
(e) returning the refrigerant through the condenser to the compressor

Operating pressures and compressor temperatures are similar to those in air-conditioning systems. The mixed refrigerant charge is hermetically sealed into the system; normally neither it nor the compressor lubricating oil requires replacement or recharging.

The chiller is designed and has been factory tested to cool a flow of gaseous nitrogen entering at a nominal 60 psig at 80^{o}F down to -85^{o}F or colder as measured at the chiller exit. It is designed to be operated continuously.

MAINTENANCE

INTRODUCTION

This section of the manual contains information for use in preventive maintenance, trouble shooting and corrective maintenance.

PANEL REMOVAL

Removal of only three panels are necessary to access the electronics, the air dryer assembly and the compressor unit. These covers are held in place with snap-on catches and are removed by pulling them off and pushing them on. No tools are required.

Top Cover - Remove the top cover by grasping the rear edge of the panel and pulling upward. The control unit is under the top cover.

Rear Cover - Remove this cover using the recessed hand grips on top edge of rear panel and pull outward. The top cover must be removed first to expose the hand grips. The air dryer and refrigeration unit are behind the rear cover.

Left Side Cover - Remove this cover in a similar fashion like the rear cover.

PREVENTIVE MAINTENANCE

Introduction

Preventive maintenance consist primarily of cleaning and replacement of air filters, the refrigeration condenser and visual inspection. When performed on a regular basis, preventive maintenance can prevent equipment breakdown and ensure reliability. The severity of the environment to which the equipment is subjected will determine the frequency of maintenance. The recommended interval for performing preventive

maintenance is three months.

Cleaning

Exterior - Loose dust accumulated on the outside of the equipment can be removed with a soft cloth or small paint brush (seams, joints, etc.). The paint brush is particularly useful for dislodging dirt on and around the front panel controls. Dirt which remains can be removed with a soft cloth dampened in a mild solution of detergent and water. *Abrasive cleaners and chemicals such as Acetone, Benzene, Carbon Teracholoride etc., should not be used.* Alcohol (Methanol) may be used.

Fan Filter - Remove and clean the snap-on fan filter located on Control Box rear panel. The filter should be cleaned with compressed air or replaced if necessary.

Refrigeration Condenser - Lint and dust accumulation must be periodically removed from the condenser. The procedure is as follows:

1. Remove left panel. See chapter *Panel Removal* under section *Preventative Maintenance.*
2. Clean condenser using compressed air and a small brush to dislodge any lint trapped in the finns.

Visual Inspection

The equipment should be inspected occasionally for such defects as defective or loose hardware, loose electrical or pneumatic connections, damaged or improperly installed circuit boards and heat damaged parts.

Test Aids

Diagrams - Showing gas paths, air dryer assemblies and electrical assemblies are included for a better understanding of the system.

Diagnosis - A complete set of built in diagnostics is available to the operator for each fault condition. Each time the power is turned on, a self test cycle is automatically initiated and an error message will be displayed on the display screen if a fault has occured. A list of diagnostic messages and corrective action are included in paragraph *Display Panel Error Messages*.

Terminal - A RS-232C Terminal with a Baud rate setting of up to 9600, connected to the rear panel, can serve as an effective trouble shooting tool for isolating problem areas. Refer to paragraph *Trouble Shooting With Terminal* under subsection *Trouble Shooting*.

Air Filter Replacement

Three air filters located on the air dryer assembly required periodic attention. The filters are accessed after first removing the rear panel. *Always disconnect the air source when servicing the air filters.*

Water Separator Filter - Remove and clean the filter bowl and replace the filter element using the following procedure (see Figure 9).

1. Manually unscrew filter bowl counter-clockwise. Do not use hand tools such as pliers or wrenches (see Figure 9 and Figure 10).
2. Remove Phillips head screw (bottom side) from filter element assembly (see Figure 12).
3. Remove and discard the filter element (see Figure 13).
4. Clean the bowl and all parts removed in a solution or mild detergent.
5. Re-assemble filter assembly using a new filter element, Thermonics part no. P5-020.

Coalescent Filter - Remove and clean the filter bowl and replace the filter element using the following procedure (see Figure 14).

1. Grasp collar at top end of bowl, press tab and rotate counter-clockwise one notch (see Figures 15 and 16).
2. Set collar aside and pull bowl off seating area (see Figure 17).
3. Grasp filter element and rotate counter-clockwise. Remove and discard (see Figure 18).
4. Clean the bowl in a solution of mild detergent.
5. Install a new filter element. Use Thermonics part no. P5-019.
6. Position bowl in seating area and firmly press into place.
7. Install collar while holding tab and rotate clockwise one notch until audible click is heard.

Dust Filter - Requires replacement of the element (see Figure 19).

1. Disconnect 3/8" tubing from dust filter.
2. Using two 3/4" open end wrenches, unscrew the end-cap fitting from the main body. When removing the end-cap, be careful not to drop the o-ring or spring.
3. Remove the old filter element and replace with a new one, Thermonics part no. P5-010.

Desiccant Replacement

The recommended replacement interval for the desiccant is 12 months. A more frequent replacement indicates that the quality of the air source is not suitable and probably contains excessive amounts of moisture and oil. The replacement procedure is as follows:

1. Disconnect 3/8" Paraflex Tubing that connects to the Input Filter, the second filter and the output dust filter using a 3/8" open end wrench.
2. Back off the four 1/4-20, Allen Head Mounting screws approximately four turns.
3. Carefully lift entire assembly up and out. Set unit on a flat surface.
4. Disconnect the paraflex tubing to the output of the Coalescing Filter. The paraflex tubing is attached to the coalescing filter, via a Prestolock Fitting and can be disconnected by pressing the plastic lip flush against the brass body and pull the paraflex tubing out.
5. Remove the bracket attached to the mounting plate that holds the coalescing and particulate filter.
6. Replace filter elements and clean filter bowls as described in paragraph *Visual Inspection*
7. Disconnect the paraflex tubing at the bottom of the right side. Disconnect tank (prestolock fitting).
8. Disconnect the two polyurethane lines from the 4-way valve.
9. Remove the two screws that secure the 4-way valve to the mounting plate.
10. Lift Air Dryer up way from mounting plate to a right angle.
11. Rotate the 4-way counter-clockwise until the fitting disconnects from the Desiccant Tank.
12. Remove the brass elbow from the adjacent tank.
13. Pour the desiccant from the two tanks and discard.
14. Unscrew each tank and remove from the assembly.
15. Rinse the tanks in a soapy solution to remove any residue that may have accumulated.
16. Re-install both tanks and elevate at a right angle.
17. Pour into each tank 3 pounds of Molecular Sieve, part number P5-015.
18. Re-assemble and install the Air Dryer in the reverse order as described above.

Mechanical Refrigeration Unit

Refrigeration Condenser - Requires periodic cleaning to ensure adequate cooling efficiency. Dirt dust and other accumulated matter must be removed from the condenser monthly using compressed air. The assembly is accessed through the rear and left side panels of the cabinet.

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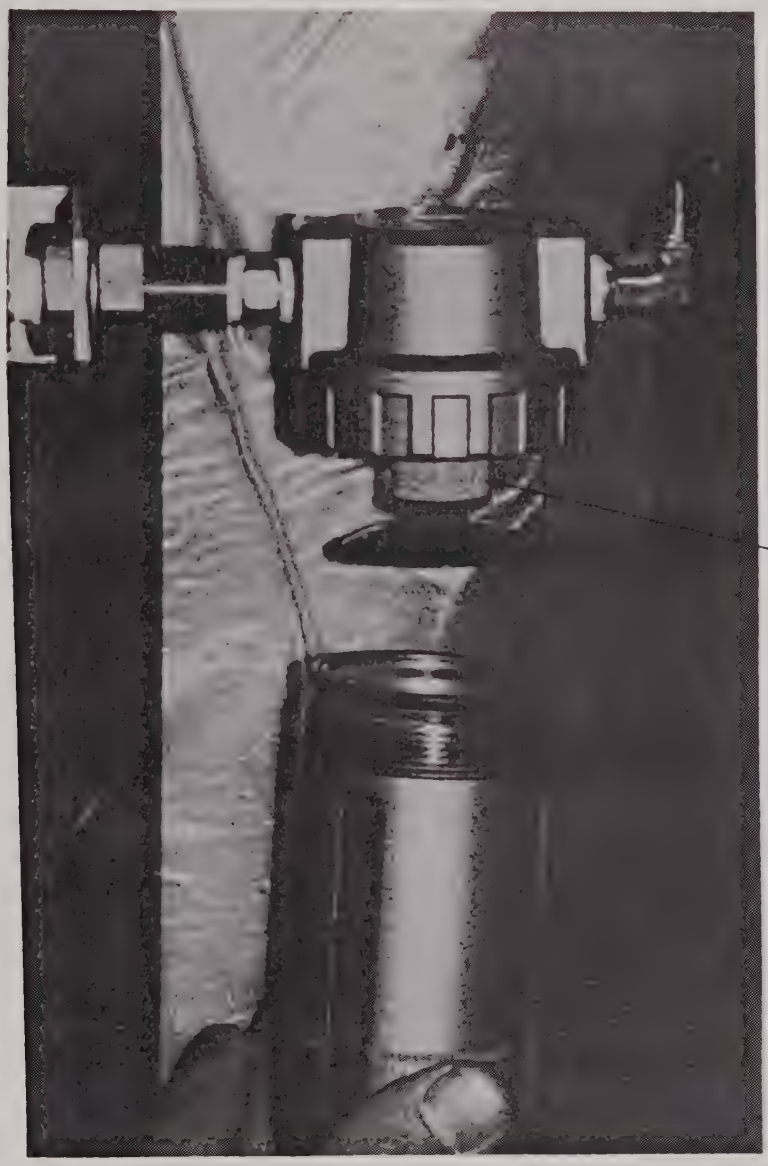

Figure 9.

Remove Filter Bowl From Body

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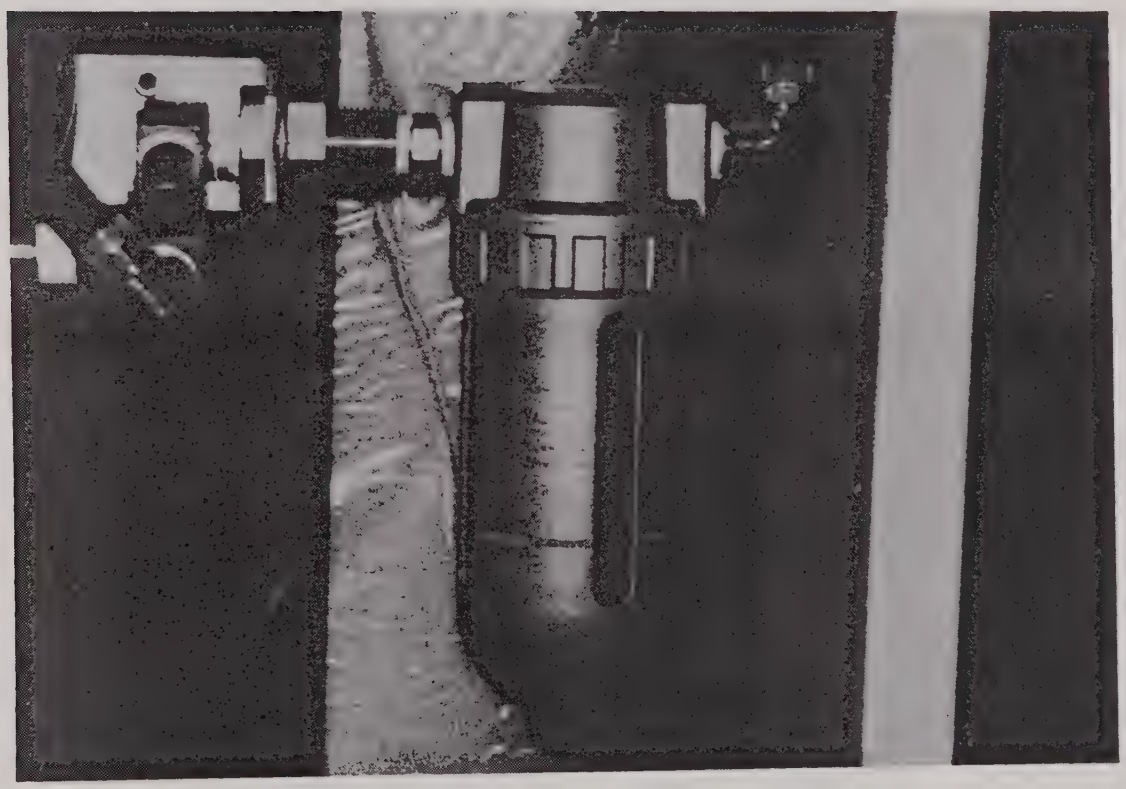

Figure 10.
Water Separator Filter

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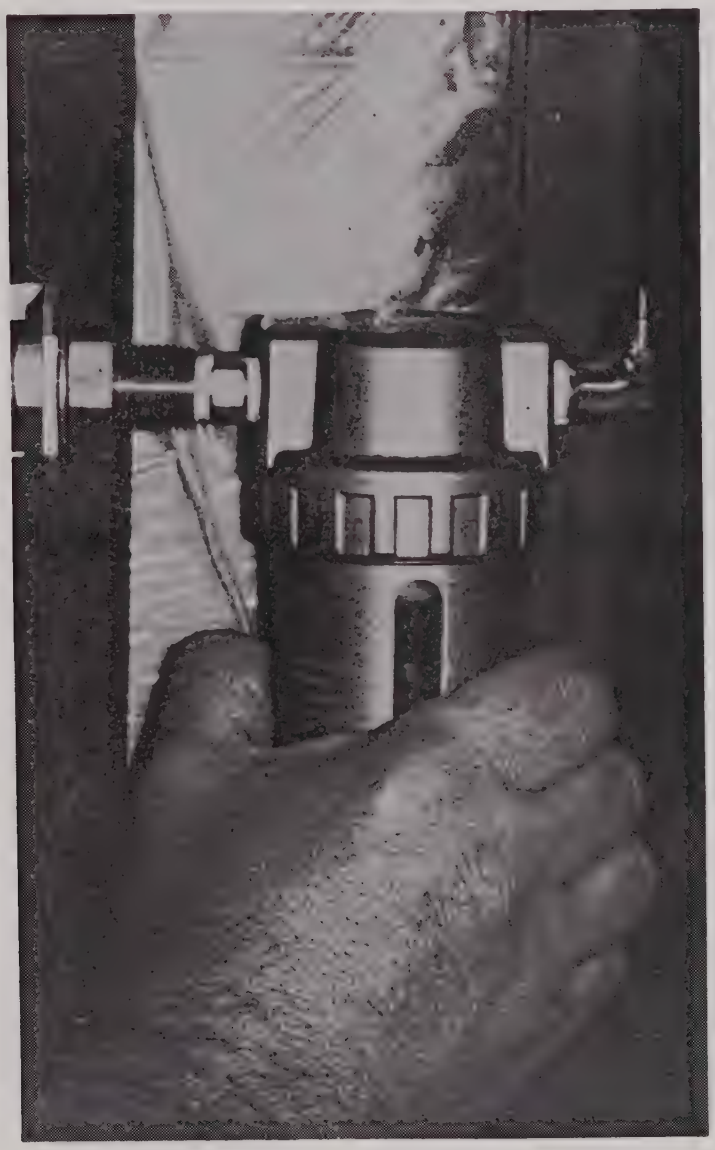

Figure 11.
Removing Filter Bowl Without Tools

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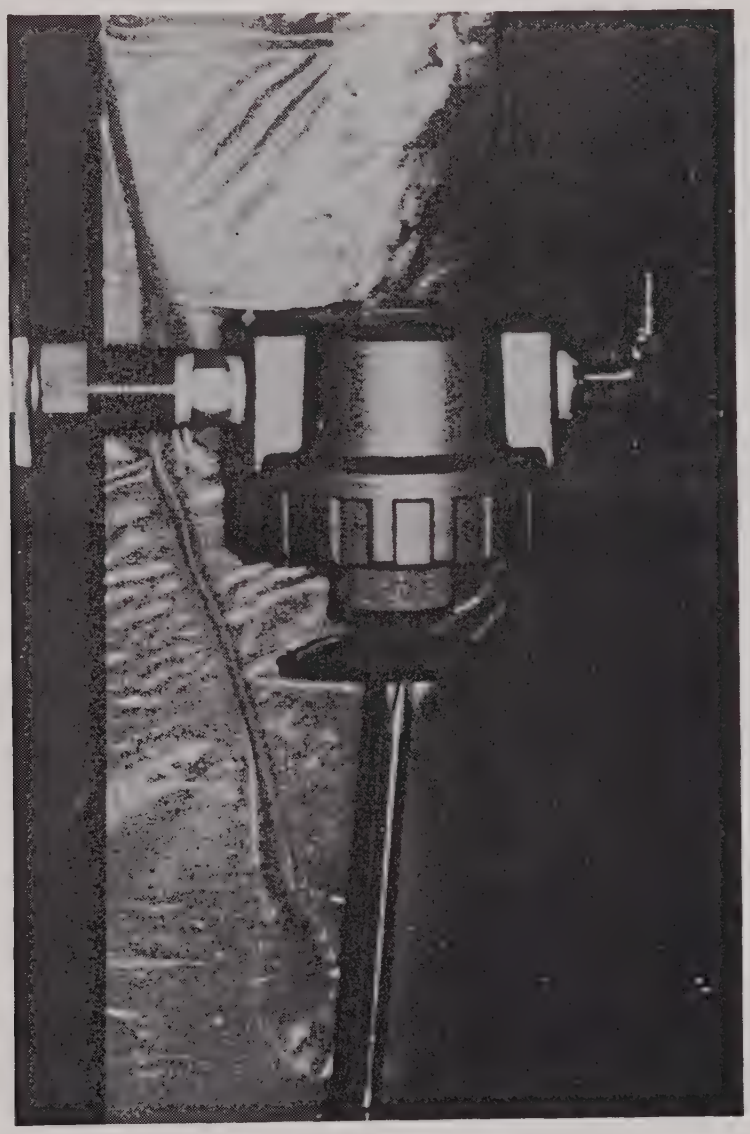

Figure 12.
Removing Filter Element

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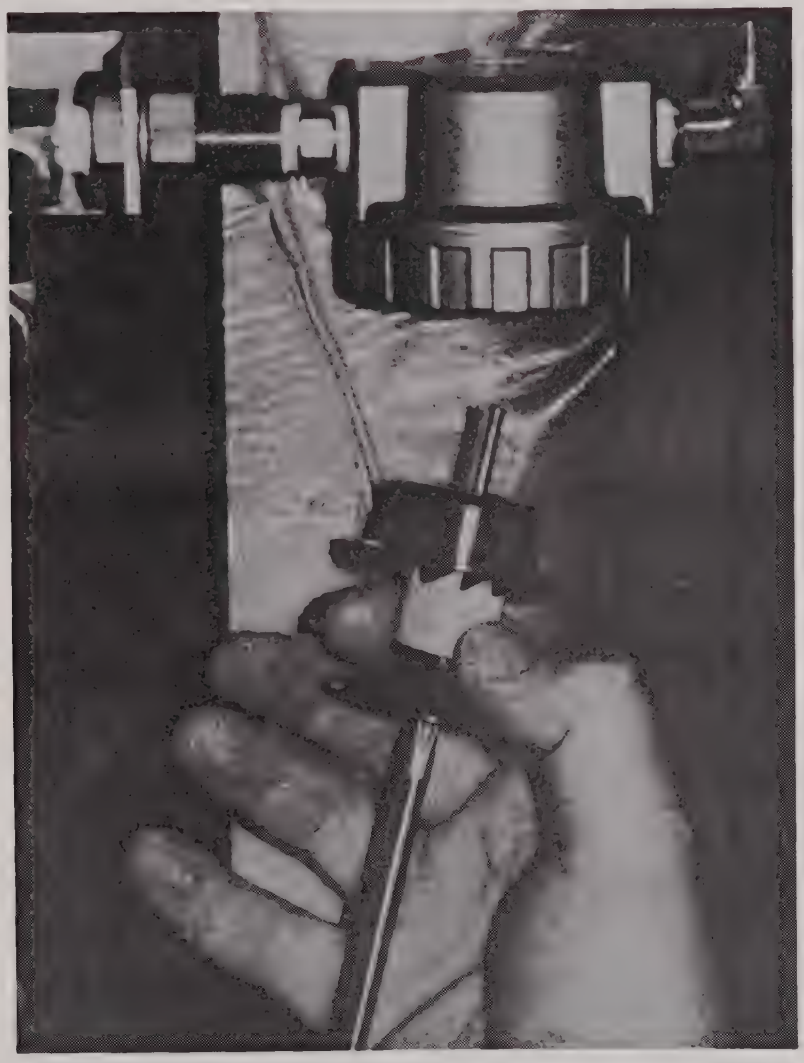

Figure 13.
Removing Filter Element

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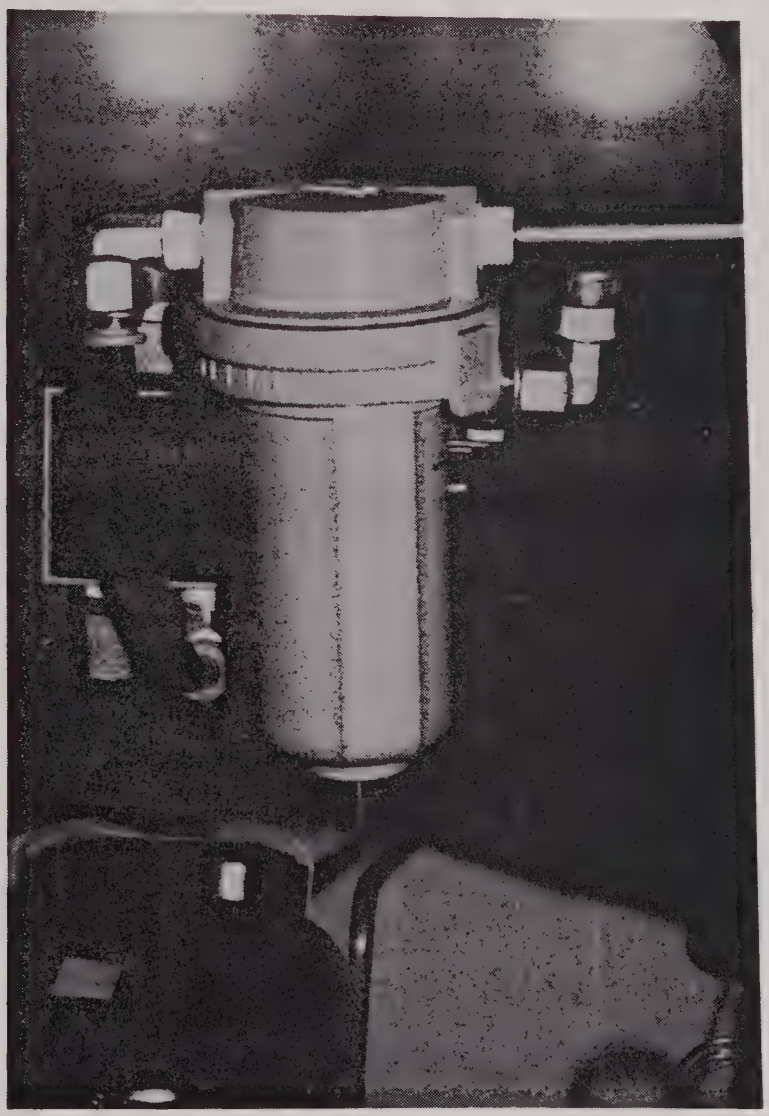

Figure 14.
Coalescent Filter

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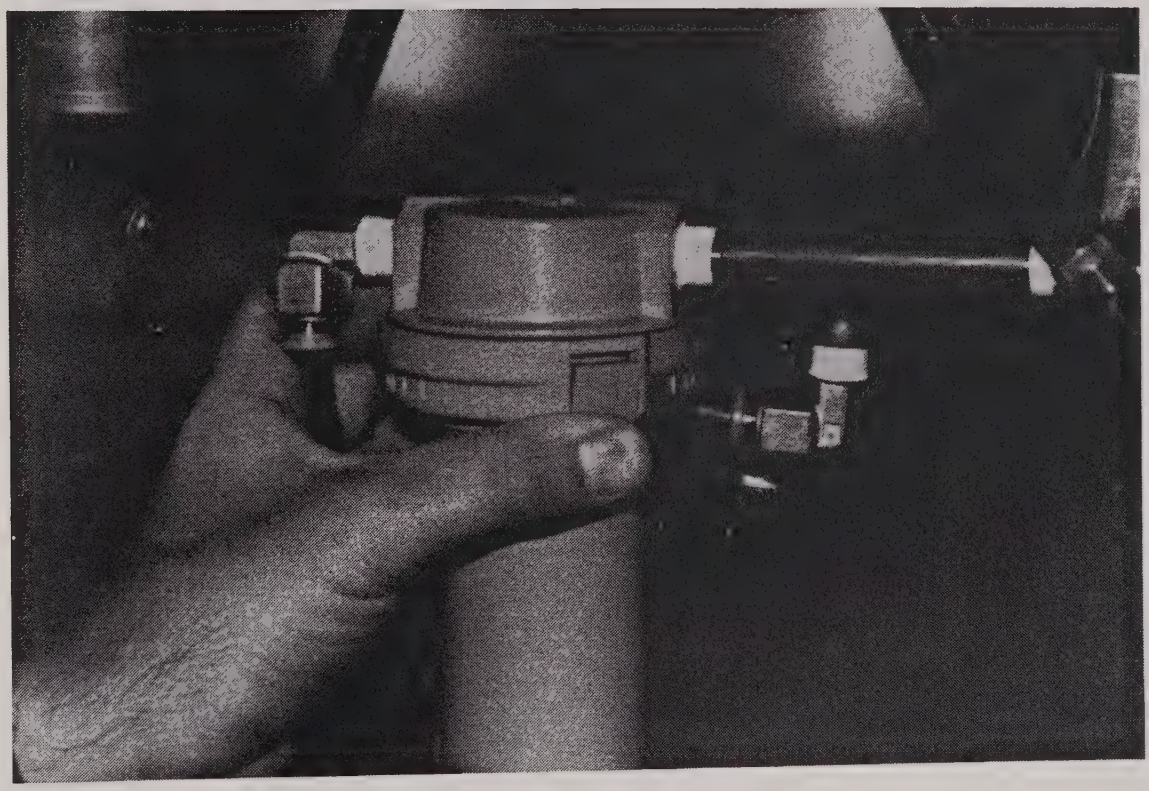

Figure 15.

Press Tab & Rotate Counterclockwise to Remove

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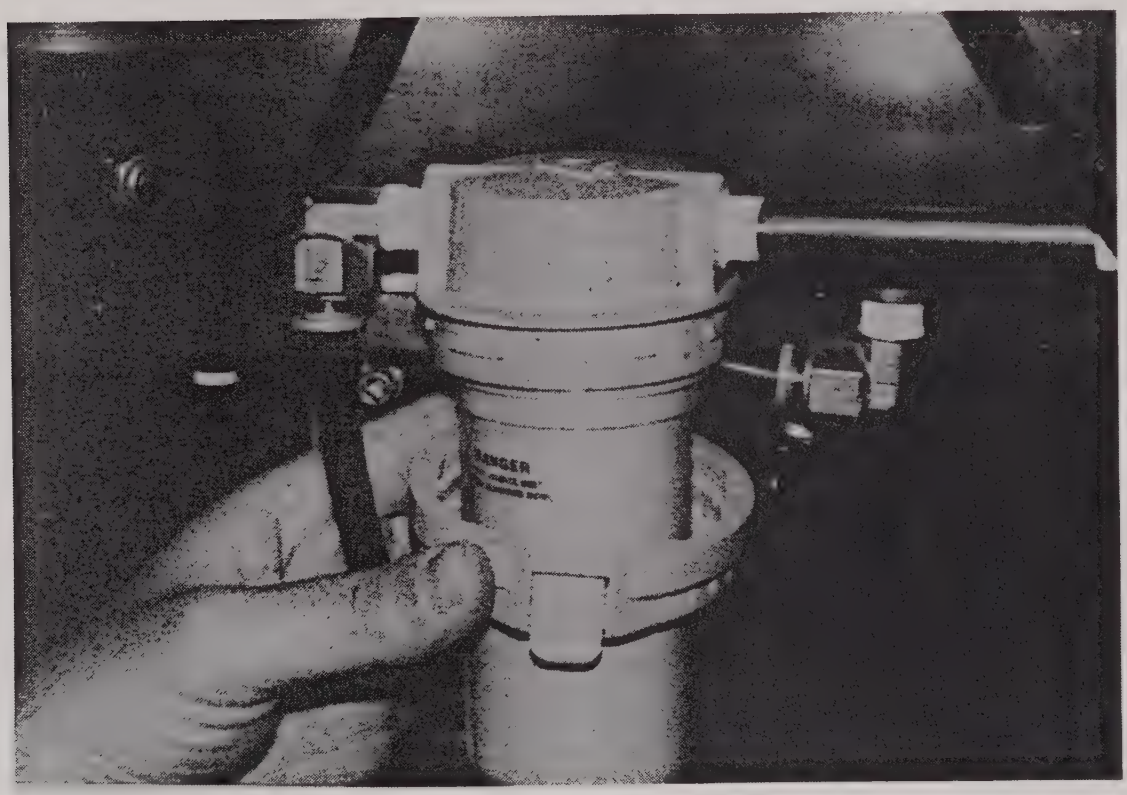

Figure 16.
Remove Collar & Set Aside

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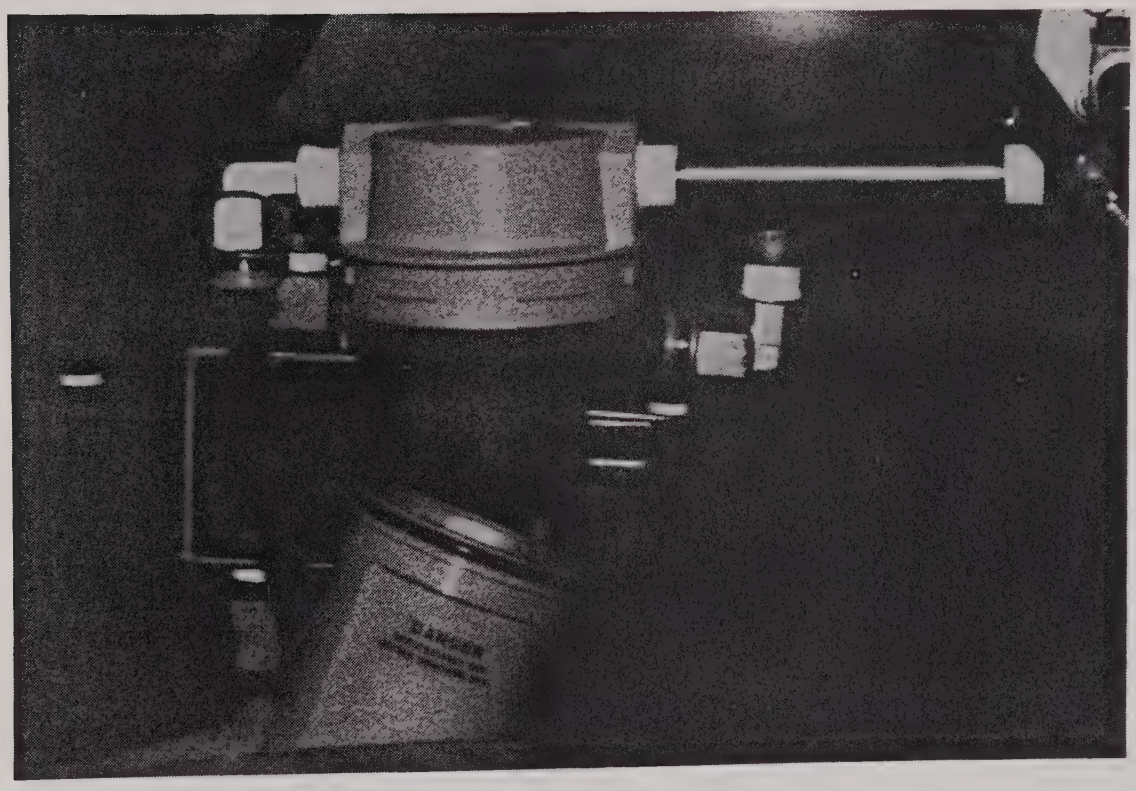

Figure 17.

Coalescent Filter

Remove Filter Bowl & Set Aside

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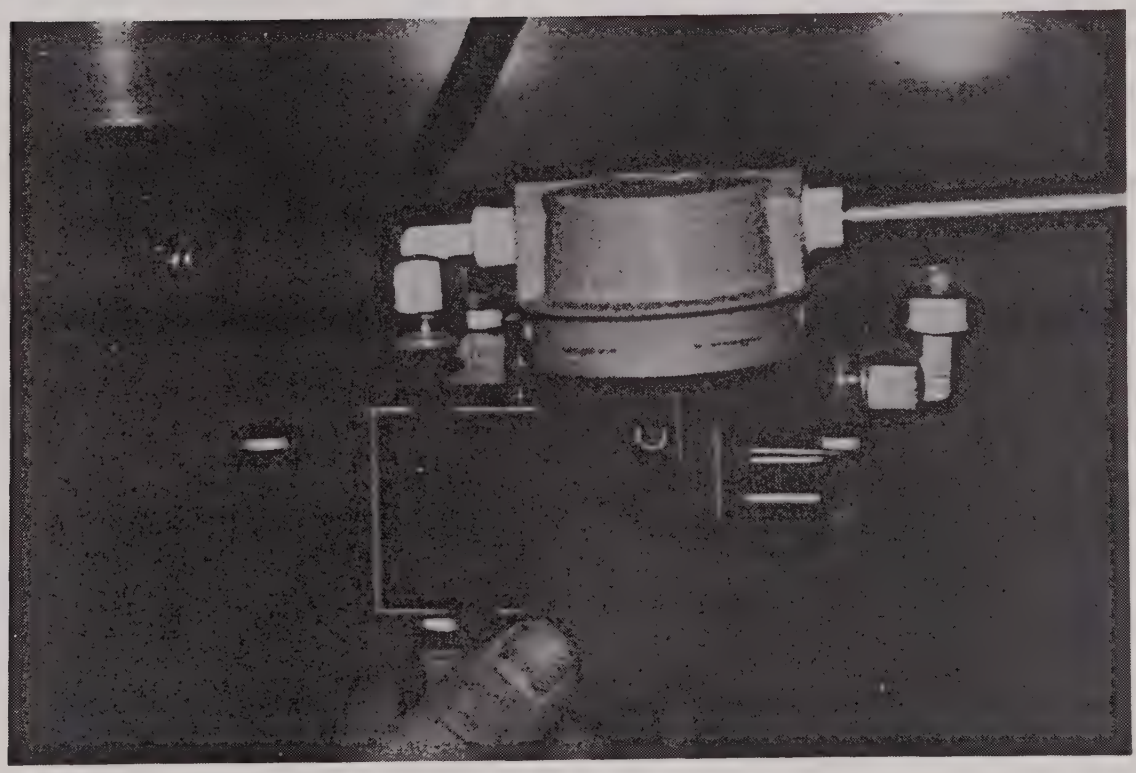

Figure 18.

Coalescent Filter Element

Rotate Counterclockwise & Remove

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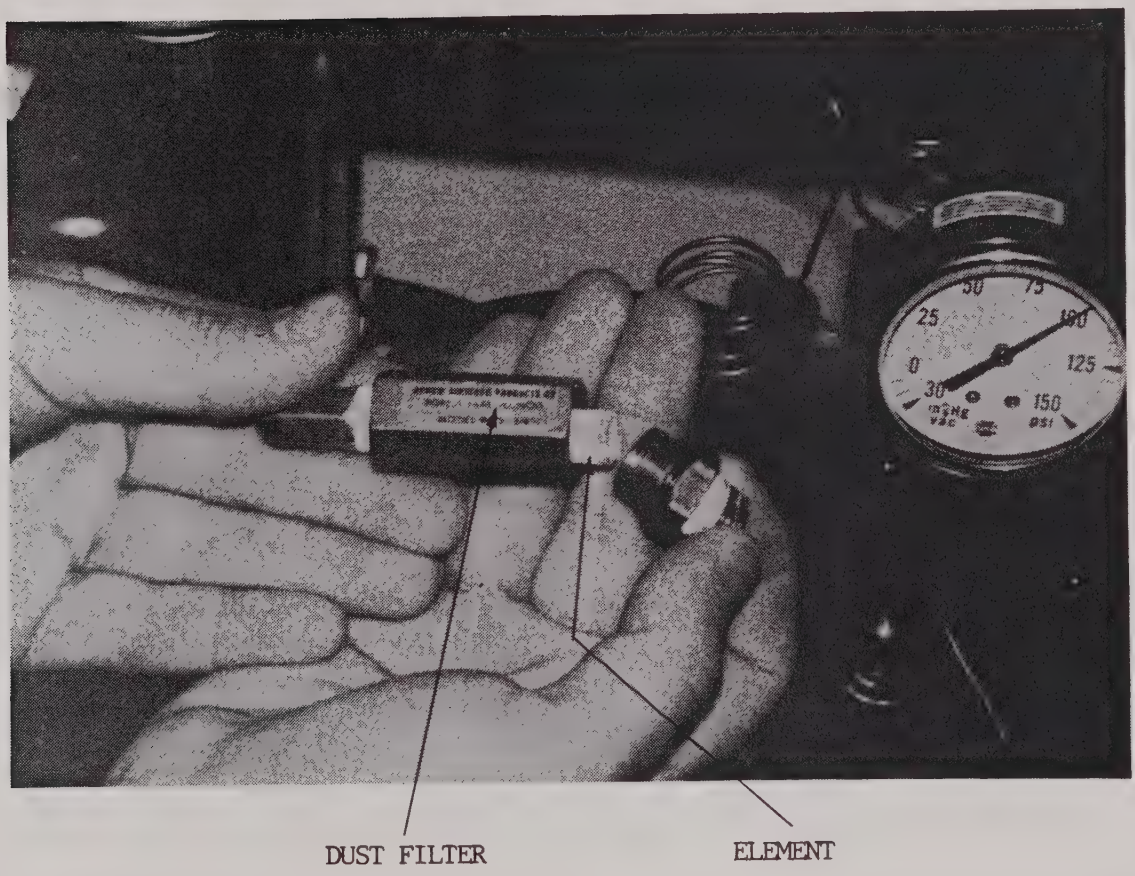

Figure 19.

Remove Element From Dust Filter

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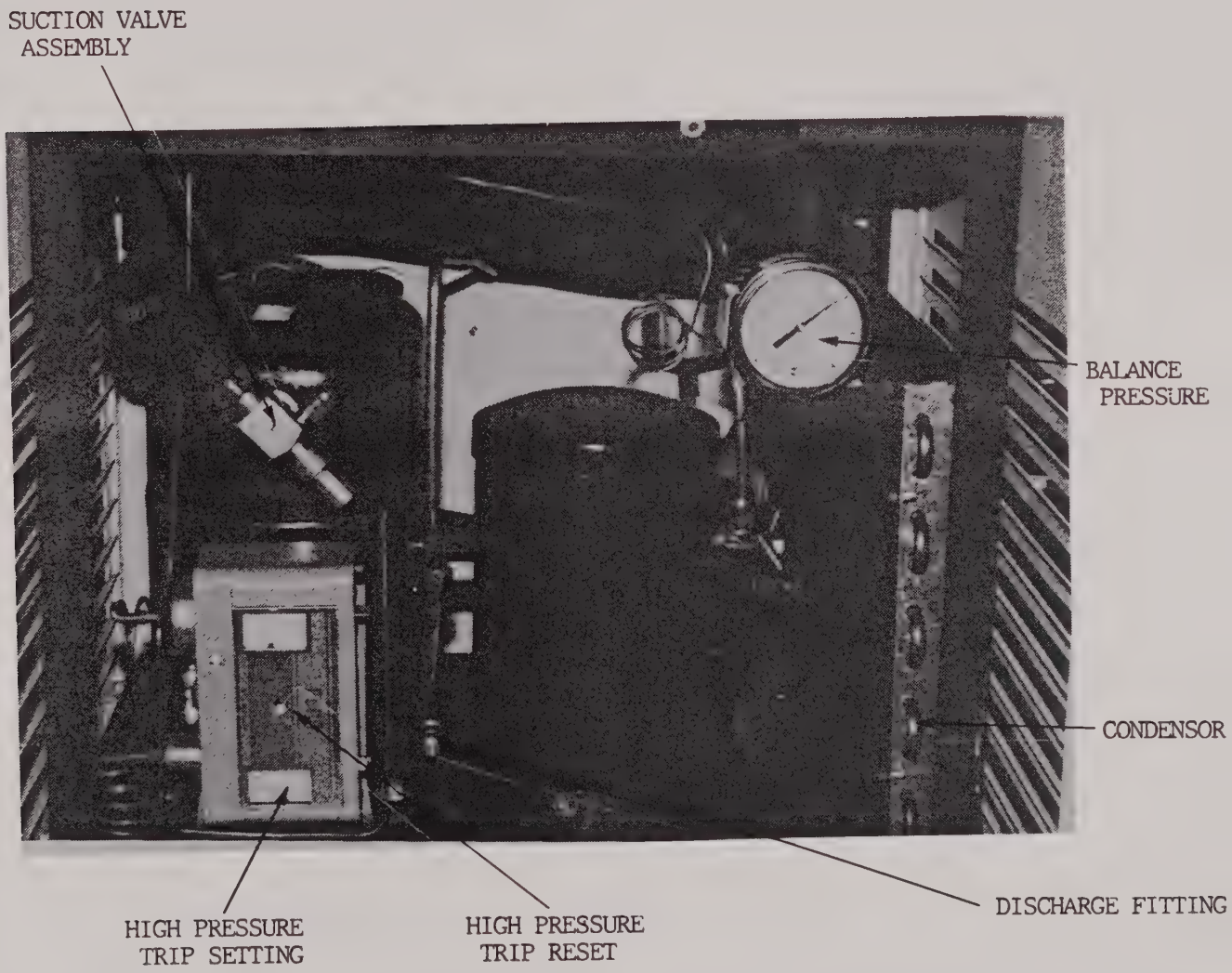

Figure 20.

Suction Valve Assembly

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Lubrication - No regular or periodic lubricating or oiling is required. The compressor and condenser fan motors are factory lubricated.

Inspection - The refrigeration unit should be periodically inspected as follows:

1. Balance Pressure - Observe that the balance pressure is 22 to 40PSI when operating and at 90 to 110PSI when left off overnight.

2. Compressor Temperature - The temperature of the compressor motor is considered to be normal if one can comfortably hold his hand on the case for a period of time. Excessive case temperature indicates to high a line voltage or too much refrigerant installed.

3. Frost - Observe that no frost build-up occurs on the Suction Valve Assembly. A small accumulation of moisture is acceptable. (see Figure 20).

THERMAL TEST FIXTURE WITH PNEUMATIC LIFT

The Pneumatic Lift thermal fixtures require periodic cleaning of the Lift Guide Rails. No lubrication is required.

Inspection - The Guide Rails should be periodically inspected for build-up of dirt, grease or other foreign matter. The fixture should be manually raised and lowered and any binding and restricted movement noted.

Cleaning - Clean with alcohol (Methanol) using a soft dampened cloth.

MOVABLE ARM AND THERMAL FIXTURE

The movable arm and thermal fixture requires periodic cleaning of the elbow, pivot joints and the lift guide rail. All joints are pre-lubricated and require no further lubrication.

Inspection - Inspect the guide rails and joints for a buildup of dirt, grease or other foreign matter. Operate each joint and inspect for binding and restricted movement.

Cleaning - Clean with alcohol (methanol) using a soft dampened cloth.

TROUBLE SHOOTING

Introduction

The following information is provided to facilitate trouble shooting. Information contained in other sections of this manual should be used along with the following information to aid in locating the objective component or PC Board assembly. An understanding of the circuit operation is helpful in locating problems, particularly where integrated circuits, pressure transducers and AC switches are used.

Trouble Shooting Aide

Trouble Shooting Charts - As an aide to trouble shooting, charts have been provided to isolate problems with the electronics, refrigeration and air dryer assemblies. These charts list symptoms and probable causes.

Trouble Shooting Equipment

The following equipment or equivalent is useful for trouble shooting.

RECOMMENDED TEST EQUIPMENT

DESCRIPTION	SPECIFICATION	MODEL
Digital Thermostat	-60°C to 200°C	Fluke Model 2100A
Oscilloscope	100HMZ	Tektronix 465
Digital Voltmeter	4-1/2 Digit	Fluke 8062A
Flow Meter	0 to 1000 CFH	Dwyer RMC-106-SSV
RS-232C Terminal	9600 Baud	Televideo 95

Display Panel Error Messages

In most cases, the displayed error message will accurately locate the fault. The following lists probable causes and corrective procedures for faults.

Message	Possible Cause	Repair
Selftest Running	Normal Selftest	None
XSum Error EPROM B4:	EPROM B4 on CPU Board Failed Checksum Test	Replace EPROM B4, B5 & B6 on CPU Board
XSum Error EPROM B5:	EPROM B5 on CPU Board Failed Checksum Test	Replace EPROM B4, B5 & B6 on CPU Board
XSum Error EPROM B6:	EPROM B6 on CPU Board Failed Checksum Test	Replace EPROM B4, B5 & B6 on CPU Board
Cold Fail/Safe Active	Cold heater thermostat is either defective or sensed over temperature condition	Check heater wiring and thermostat. Check AC switch.
Hot Fail/Safe Active	Hot heater thermostat is either defective or sensed over temperature condition	Check heater wiring and thermostat. Check AC switch.
I/O Board Error 1:	Resistance measurement are erratic or overrange	Check I/O Board seating, clean connec- and check connections. Check RTD sensors.
No Temperature Sensors	Sensor wiring or sensor open or AC Switch is defective	Check sensor. Check sensor wiring. Replace if necessary.
Hot Heater Failure:	Hot heater winding open or AC switch is defective.	Check hot heater. Check AC switch. Check heater/AC switch wiring.
Cold Heater Failure:	Cold heater winding open or AC switch is defective.	Check cold heater. Check AC switch. Check heater/AC switch wiring.
Purge Heater Failure:	Purge heater winding open or AC switch is defective.	Check purge heater. Check AC switch. Check heater/AC switch wiring.

Trouble Shooting with Terminal

An RS-232C terminal connected to the rear panel can be used for remote operation or serve as a diagnostic tool. The connection and setup procedure is as follows:

1. Connect RS-232C interconnect cable from terminal to connector on backside of PTFS labeled RS-232C I/O. Insure that the following connector pins are used.

Pin No.	Description
1	Protective Ground
2	Data Input to PTFS
3	Data Output from PTFS
6	RTS (Request to Send)
7	Signal Ground
20	DTR (Data Terminal Ready Input)

2. Set the Baud rate of the terminal for 9600 using instructions supplied by the terminal manufacturer.

3. Set the Baud rate of the PTFS as follows:

   a. Repeatedly press the front panel **SET** push-button until the front panel displays Set RS-232C Speed.
   b. Momentarily press the **ENT** key to display the current Baud rate of the PTFS.
   c. If the displayed Baud rate is satisfactory, press **ENT**. Otherwise repeatedly press the **SET** key until the appropriate rate is displayed. Press **ENT** to store the selected baud rate.

4. The PTFS now asks for a handshake mode. The correct handshake mode is XON/XOFF and is selected as follows:

   a. If the display panel displays XON/XOFF, then press the **ENT** key.
   b. Otherwise repeatedly press the **SET** key until XON/XOFF is displayed and then press the **ENT** key.

5. The PTFS now requests the parity. The correct parity is "No Parity".

   a. If the display panel displays No Parity, then press the **ENT** key.
   b. Otherwise, repeatedly press the **SET** key until No Parity is displayed. Press the **ENT** key.

6. The PTFS now requests Echo. The correct Echo is "Auto Echo".

   a. If the display panel displays Auto Echo, then press the **ENT** key.
   b. Otherwise, repeatedly press the **SET** key until the Auto Echo is displayed. Press the **ENT** key.

The terminal will now display the following messages.

T-2420 Diagnosis Program V. X.X 860122
Available Options
<1> Display A/D and scaled values
<R> Remote Operation
Select Option

Select the diagnostic mode by pressing the "1" key at the terminal. The terminal now displays two groups of data, Raw unscaled and scaled data. A typical display with a set temperature of +200°C and a flow-200SCFH will appear as follows.

2628	15420	15420	15420	-3444	17	1748	2470
-455	29	1556	1634	-59	838	1255	
2000	15420	15420	15420	0	9990	14987	227
1494	262	2137	2234	153	3354	0	

The first two rows are raw, unscaled data and are not often used for diagnostic testing. The second two rows are scaled data consisting of the following information when read from left to right.

Hose Sensor (RTD) - Temperature measured at fixture (X10). Same reading displayed on front panel.
Not used.
Not used.
Auto Calibration (RTD) - Temperature of auto calibration RTD. No sensor connected in example.
Ground Offset (RTD) - Voltage offset added to RTD to compensate of circuit resistances.
Precision Resistor Voltage (1.0K) - Reference voltage used for auto calibration.
Precision Resistor Voltage (1.5K) - Reference voltage used for auto calibration.
I/O Board Temperature Sensor - Measures ambient temperature of card cage (X10). Used for thermocouple temperature compensation.
Precision Resistor Voltage (1.5K) - Reference voltage used for auto calibration.
Merge Block Thermocouple (Cold) - Measures gas temperature at cold heater output (X10).
Merge Block Thermocouple (Hot) - Measures gas temperature at hot heater output (X10).
Purge Heater (Thermocouple) - Measures purge heater temperature (X100).
DUT Sensor (Thermocouple) - Temperature measured by DUT thermocouple.
Flow Transducer (Hot) - Gas flow through hot path (X10).
Flow Transducer (Cold) - Gas flow through cold path (X10).

Mechanical Refrigeration Trouble Shooting

The following is a list for potential problems and probable causes.

Problem	Possible Cause	Repair
No air flow after operating for a period of time.	Excessive moisture in air source. Ice buildup restricts or plugs heat exchanger.	Check air source for excessive moisture. Check air dryer operation.
Compressor starts, but cycles off after a short period of time.	Voltage drops due to extension cord, loose power plug connection or undersize wire.	Inspect power cord.
	Low line voltage. Too much refrigerant charge.	Check overnight balance pressure.
	Overload protector trips due to excessive current drain.	Measure current. Check compressor motor for possible shorted winding. Measure current.
		Defective start relay. Compressor does not switch from start winding to run winding.
	Overload protector trips due to compressor motor case too hot.	Check case temperature. Should be able to rest hand on case for a period of time.
		Check for too much refrigerant charge.
		Check for high line voltage.
Compressor does not start. Condensor fan operates.	High pressure reset is set.	Manually reset high pressure trip push-button. See figure
		Check high pressure setting on reset panel, should be set for 400 PSI.

Air flow does not get cold enough.	Ice buildup in heat exchanger. Oil film buildup in heat exchanger Possible lose of refrigerant. Air flow through condensor is restricted due to lint, dust or other foreign matter.	Purge water from systems. Check air dryer operation. Flush oil from heat exchanger. Check refrigerant charge. Clean condensor.

Other Trouble Shooting Hints

Compressor is Operating - The compressor will not operate if the manual reset dual pressure cut-out trips. If the condition occurs, the condenser fan will continue to operate and the balance pressure gauge will display a pressure in excess of 40 PSI. Reset by manually pressing the reset push-button. Occasionally the reset button is difficult to reset and may require additional pressure.

If compressor does not operate and condenser fan is off, check for open power connections to the compressor.

Compressor Cycles On and Off - The compressor will cycle on and off if the overload protector sets and resets. It will set when the compressor draws excessive current or the case temperature is excessive. In either case, the protector self resets.

The temperature of the compressor is considered to be normal when one can comfortably rest his hand on the case for a period of time.

Current in excess of 10 amps will cause the protector to set.

If the case temperature and the current are acceptable, then the overload protector is defective and must be replaced. Refer to paragraph, *Overload Protector Replacement.*

Condenser Operation - The condenser is considered to be functioning correctly when the temperature of the 3/8 inch tube (lower left hand of condenser) is just warm to the touch. Improper operation of the condenser can be caused by:

* Accumulation of lint and dust on the condenser. Refer to paragraph, *Cleaning Refrigeration Condenser.*
* Restricted air flow through condenser due to the close proximity of other equipment.
* Defective fan motor or loose fan blade.

Partial Loss of Refrigerant - If a loss of refrigerant is suspected, the pressure on the side mounted pressure gauge should be checked as follows:

Pressure	Remarks
26-32 PSI	Compressor operating 30 minutes.
90-110	Compressor powered off for at least 12 hours.

Air Dryer Trouble Shooting

The air dryer is designed to provide years of trouble free service if properly maintained. The performance can be severely degraded if the input or output filters become clogged, if leaks develop in the pneumatic lines or the desiccant becomes saturated with water or oil.

A good indicator of performance is:

a. Cycle rate is 90 ± 30 seconds
b. Refrigeration unit does not freeze up and no vapor is detected at hose output

The following is a list of potential problems and probable causes:

Problem	Possible Cause	Repair
Does not cycle.	Leak in pneumatic lines. Leak at orifice ring. Defective or clogged air restrictor or filter.	Repair leak as required. Replace restrictor.
Cycle rate is too short or long.	Leak in pneumatic lines.	Repair leak as required.
Restricted air flow.	One or more of the filters is clogged.	Replace filter cartridge.
Air is not dry.	Desiccant is saturated with water vapors.	Block output and connect to air source for 36 hours.
	Desiccant is saturated with oil.	Replace desiccant and filters. Flush system.

Air Heater Trouble Shooting

The purge, hot and cold air heaters (see Figure 21) can all be checked in a similar fashion. First inspect all wiring and connections to the heaters. Measure the resistance of each heater.

The resistance is checked by disconnecting one side of the heater from the card cage mounted terminal strip and measuring the resistance from that lead to the other lead at the appropriate AC switch (see Figure 22).

The terminal strip and AC switch assignments are as follows:

Heater	Terminal Strip	AC Switch	Resistance (nominal)
Purge Heater	Pin 2	K1	150 ohms
Hot Air Heater	Pin 4	K3	50 ohms
Cold Air Heater	Pin 6	K2	76 ohms

If one of the above air heaters is determined to be defective, refer to the replacement procedure at paragraphs *Air Heater Replacement* and *Purge Heater Replacement.*

Thermostat Trouble Shooting

A single snap disk type thermostat is attached to each heater case. See figure 21. The thermostats have different temperature ratings and are positioned at different points from the air heater output. See table *Thermostat Check-out.*

The thermostats are normally closed and open with temperature rise.

Trouble shooting the suspected thermostat as follows:

1. Check wiring and connector integrity to thermostat.
2. Check position of thermostat relative to air heater output (see chart below).
3. Check continuity of thermostat. Should be less than 1 OHM.

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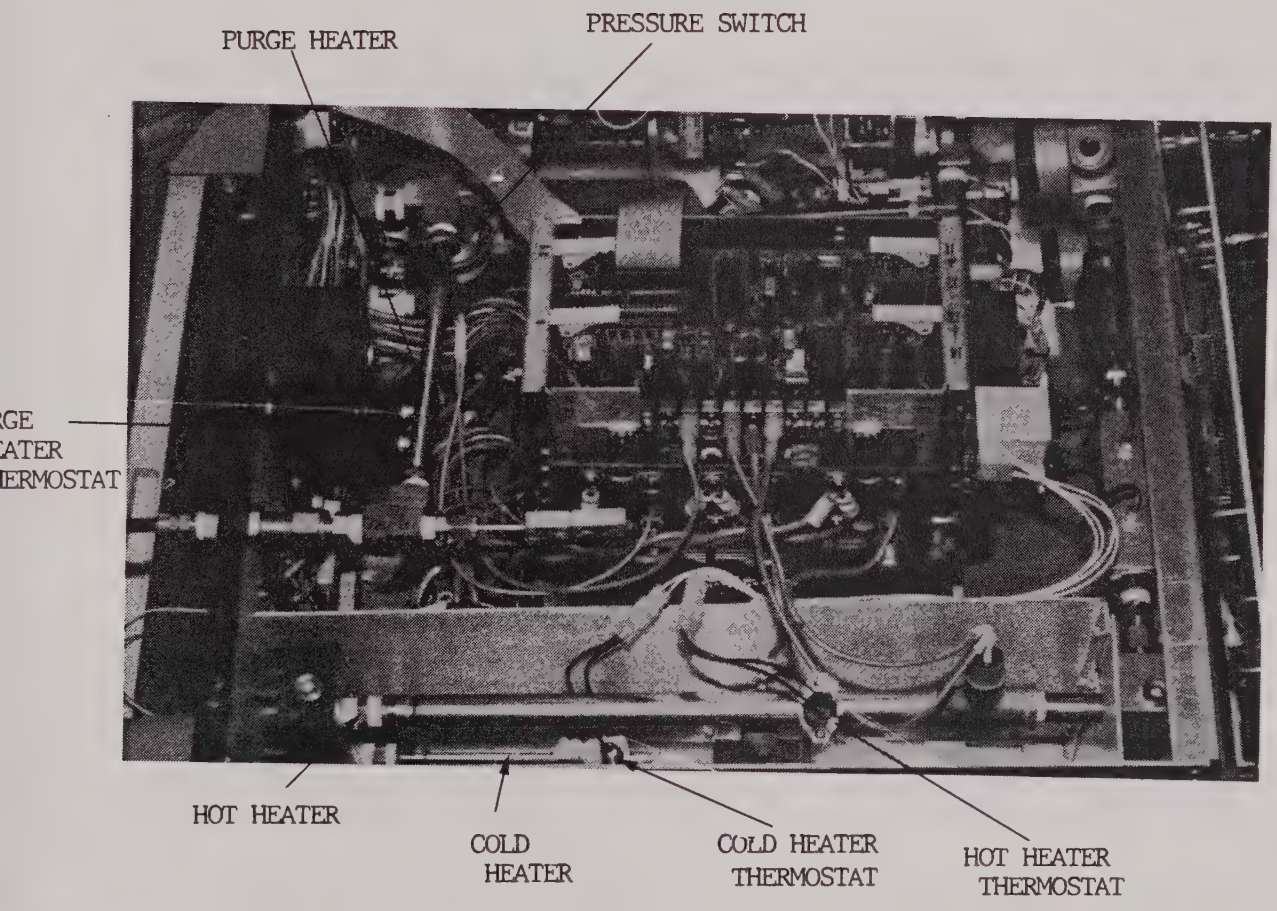

Figure 21.

Purge, Hot and Cold Air Heaters

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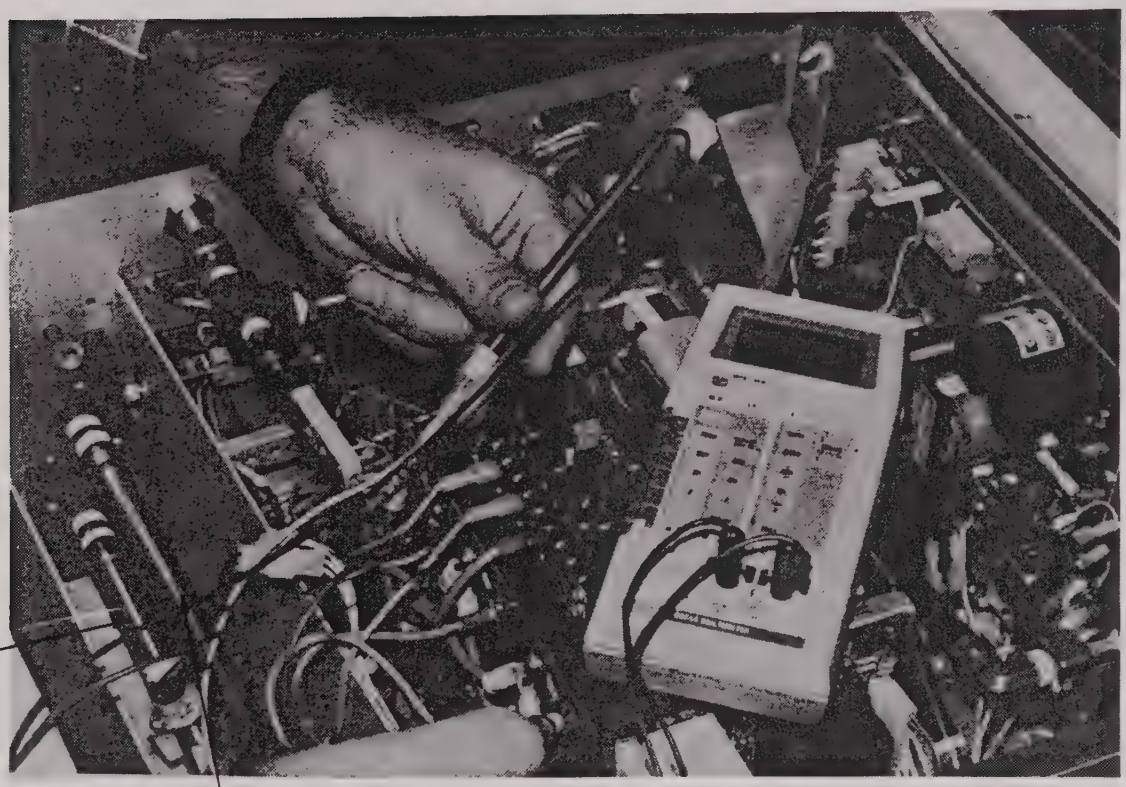

Figure 22.

Checking For Proper Heater Resistance

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The thermostat continuity is checked at J7 after first disconnecting from the Flow Board.

Thermostat Check-Out

Thermostat	Hot Air Heater	Cold Air Heater	Purge Heater
Thermonics Part No.	1R-210-1A	1R-210-1A	1R-205-1A
Temperature	350°F	350°F	160°F
Position From Heater End	8 Inches	4 Inches	2.25 inches
Continuity (Connector J7)	3 to 4	1 to 2	5 to 6

Refer to paragraph *Thermostat Replacement* for the replacement procedure.

Power Supply Trouble Shooting

The power supply is a 60 watt switching type that supplies four output voltages, ±12Vdc, ±5Vdc and 24Vdc. Trouble shooting the power supply is limited to checking the wiring connections, measure the output voltages and visually inspecting the component solder joints. If the assembly is found to be defective, the entire unit must be replaced.

Measure Power Supply Output Voltages

The connector voltage and pin assignments are as follows:

Connector	Description
P1-1	AC Hot
P1-2	AC Hot/Neutral
P1-3	AC Ground
P2-1	+12Vdc ±1.4V
P2-2	-12Vdc ±1.4V
P2-3	+24Vdc ±1.2V
P2-4	Return
P2-6	+5Vdc ±0.3V
P2-7	-5Vdc ±0.3V

The above voltages are measured under load with the cable connected. If a load problem is suspected, then the same voltage can be measured with the connector disconnected. A digital voltmeter is recommended.

Wiring Connections

Check all wiring connections for tightness. Check for oxidation or contamination build-up at the connections.

Visual Inspection

All components should be checked for tightness and good solder integrity.

Air Solenoid Trouble Shooting

Due to the inherent reliability of the air solenoids used, first, check the driver circuits for a possible problem. The two most common failures are:

1. Foreign matter or object lodged in the small orifice.
2. Coil failure.

The Flow-Control Board contains a series of LED's that show the expected state of each solenoid. The LED is illuminated when the solenoid is powered on.

Check for 120 VAC across the solenoid terminals. The slip-on lugs can be slightly pushed back to gain access to the terminals. If 120VAC is not present, the AC switch might be defective. Refer to paragraph *AC Switch Trouble Shooting.*

Switching power on and off to the air solenoid should produce a audible clicking sound. If no audible click is heard, the solenoid is probably defective.

Refer to paragraph *Air Solenoid Replacement* for the replacement procedure.

AC Switch Trouble Shooting Procedure

AC switches are located on both the Heater Control Board and the Boom Control Board (if equipped with the movable arm). An AC switch can fail in one of three ways.

1. Fully shorted
2. Partially shorted
3. Open

A shorted AC switch will cause heater run away and the protective thermostat to trip. An open AC switch will prevent the output air temperature from rising.

A neon type isolator is mounted directly below the switch to monitor its on/off status. A small inspection hole facing the top can be visually monitored to determine the status of the air heater. If the lamp is on, then the air heater is off.

Measure the voltage applied across the heater terminals to determine if the AC switch is functioning properly. The voltage will be present when the corresponding LED is illuminated.

A resistance measurement less that 1 m ohm. across the AC switch output (with heater wire disconnected) indicates a shorted AC switch.

Monitor the voltage across the AC switch (with heater connected). If the measured AC voltage is nearly 0V when the LED is on and 120VAC when the LED is off, then the AC switch is functioning properly.

Trouble Shooting Air Heater AC Switches

The standard configuration consists of three AC switches mounted on the Heater Control Board. See figure 23 for the AC switch locations.

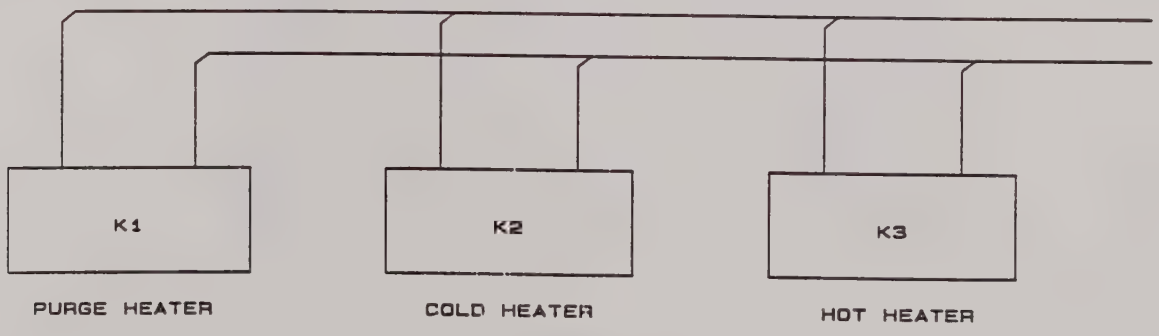

Figure 23.
AC Switch Location

Refer to *AC Switch Trouble Shooting* for checking the suspected AC switch.

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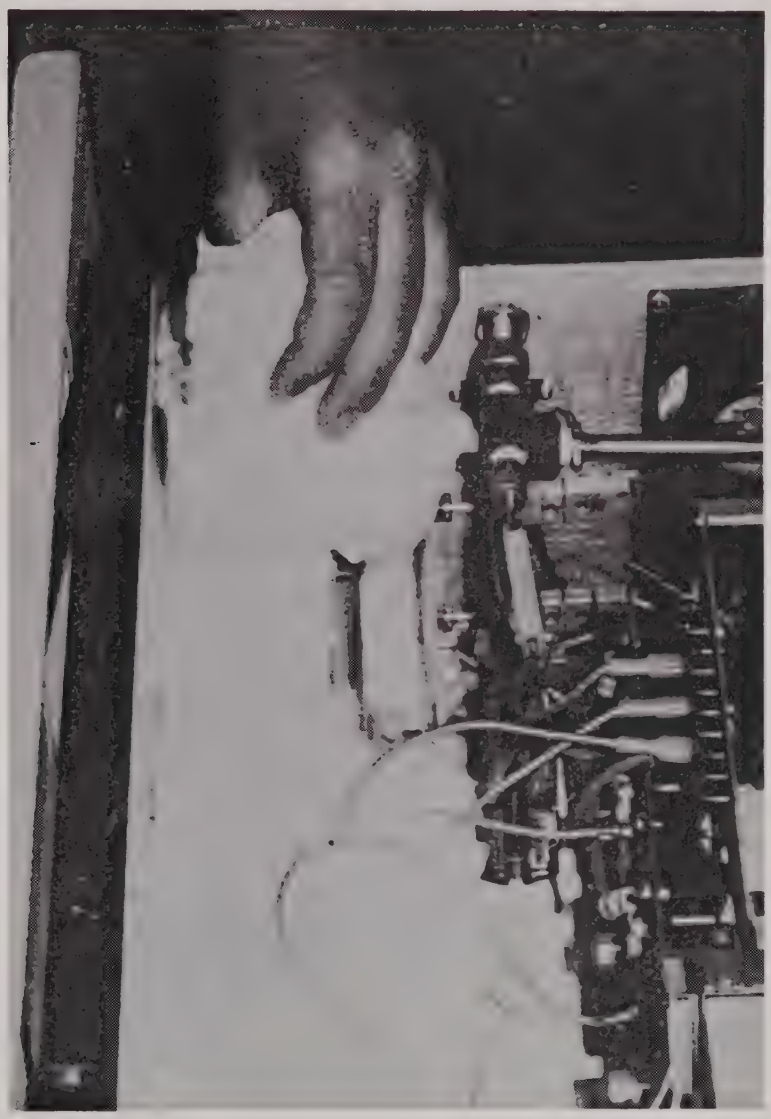

Figure 24.

Removing Refactory Fiber

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TROUBLE SHOOTING THE TF-IC2 & TF-IC4 THERMAL TEST FIXTURE

Problem	Possible Cause	Repair
Ice buildup inside the fixture.	Fixture lift open for long periods of time.	Close fixture when not in use.
	Poor fixture seal.	Check all gasket and seal surfaces. Replace defective gasketing as necessary.
	Excessive gas flow.	Reset gas flow.
Ice buildup on outside of fixture.	Purge pressure is set too low or off.	Check purge pressure.
	Purge temperature set too cold.	Check purge temperature setting.
	Poor seal between fixture top and base.	Check seal and repair as necessary.
Melting or deformation of fixture.	Air temperature set too high.	Operate at specified temperature range of fixture. Check fixture calibration.
	Poor fixture to base seal. Allow hot air to escape a seal.	Avoid running wires through seal area. Check gasket sel.
Erratic up/down operation.	Dirt on lift guide rails.	Clean lift guide rails.
	Loose air line connections.	Check for and correct all air line leaks.
	Pressure regulator set too high/too low.	Set air line pressure as required.
Gas flow does not shut off when fixture is raised.	Menu not programmed correctly.	Correct program.
	Microswitch is improperly adjusted, binds or is defective.	Check microswitch and correct condition.
	Interconnect cable at rear panel is defective.	Check sensor cable connector for loose connects, etc.

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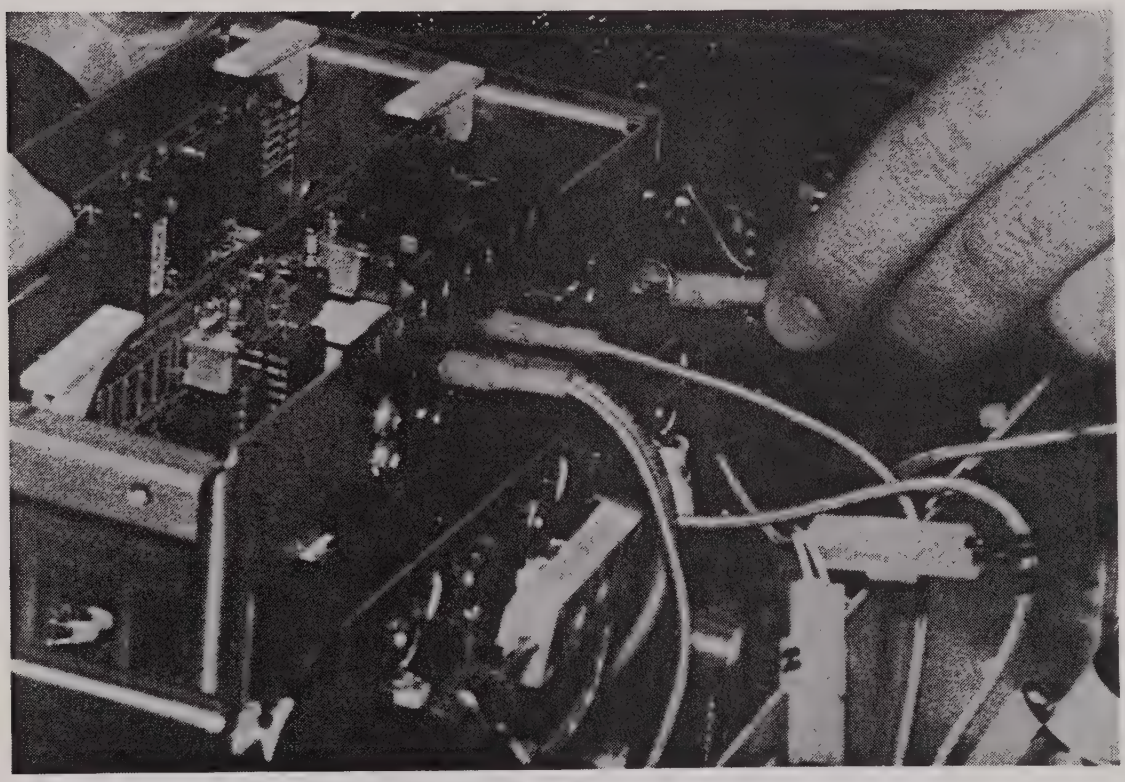

Figure 25.
Disconnecting Heater Connections at
Terminal Strip TB1

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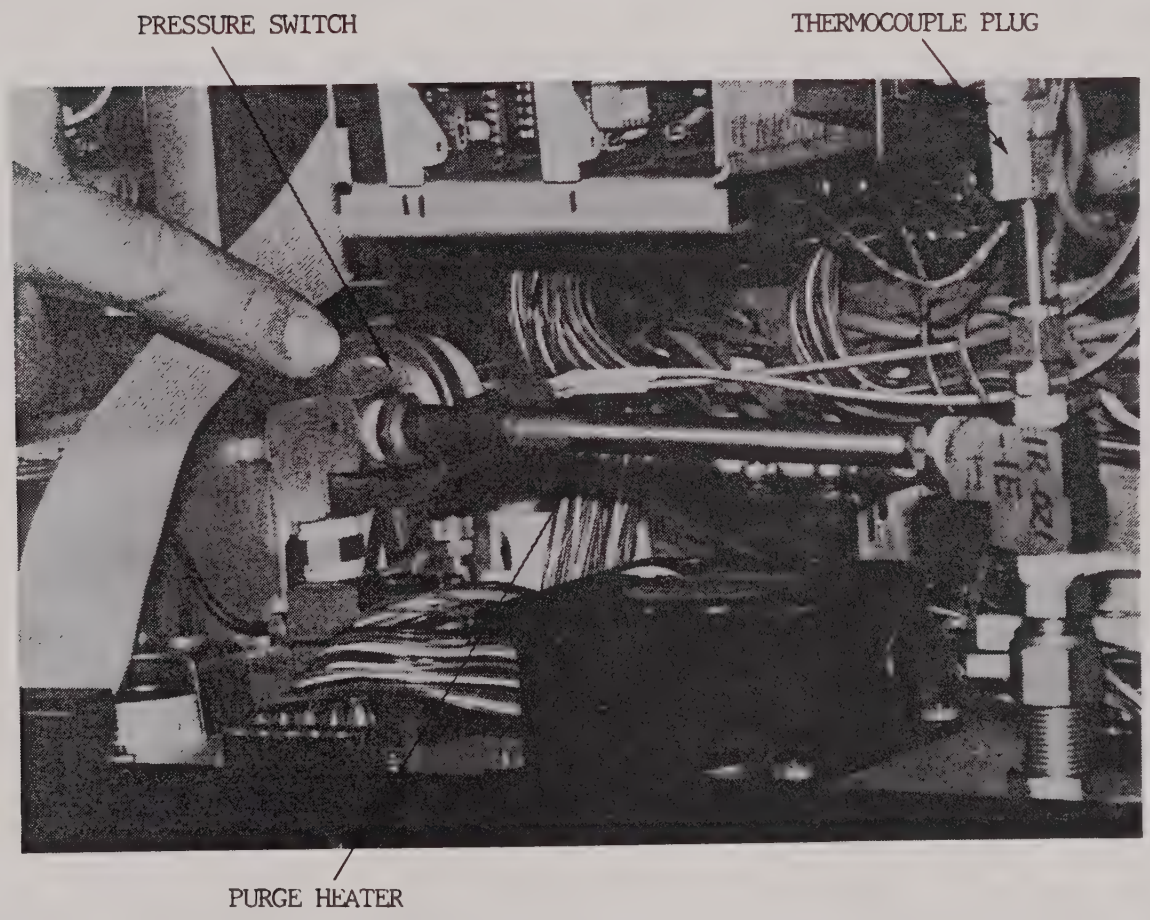

Figure 26.

Purge Heater

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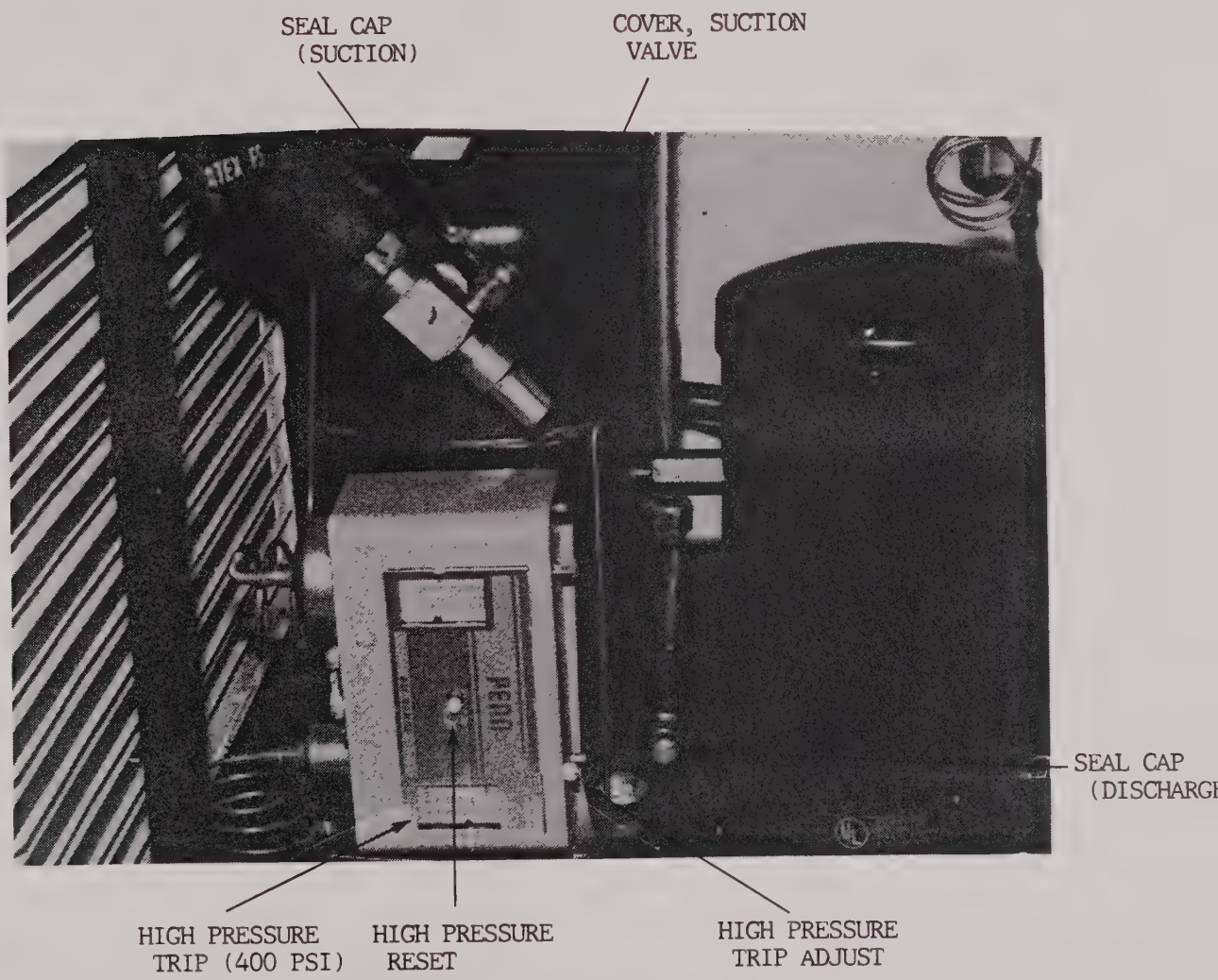

Figure 27.

Mechanical Refrigeration Unit

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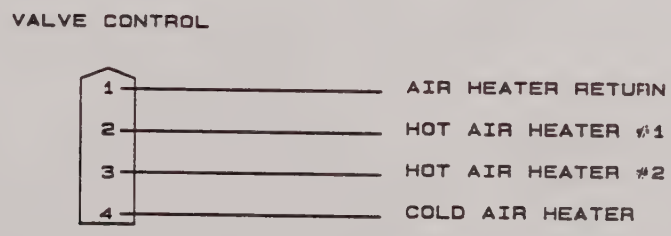
TROUBLE SHOOTING THE TF-IC3 MOVABLE ARM AND THERMAL FIXTURE

Problem	Possible Cause	Repair
Poor high temperature control. Slow transition to hot.	Open hot air heater in test head.	Check both hot air heaters in thermal test head. Replace air heater.
	Cold air diverter valve is defective.	Check diverter valve and replace if necessary.
Poor cold temperature transition time.	Defective diverter valve.	Check diverter valve and replace if necessary.
	No cold air purge.	Check cold air purge circuit. Check diverter valve.
Ice formation on test head or movable arm.	Internal cold air leak.	Locate leak and correct.

TROUBLE SHOOTING TF-IC3 HEATERS

When a defective air heater is suspected, the air heater continuity and resistance can be checked at plug "Valve Control".



Disconnect plug Valve Control measure the resistance of each air heater circuit.

Valve Control	Air Heater	Resistance
2 to 1	Hot Heater #1	80 ohms
3 to 1	Hot Heater #2	80 ohms
4 to 1	Cold Heater	80 ohms

TROUBLE SHOOTING HEATER AC SWITCHES FOR USE WITH TF-IC3 MOVABLE ARM

Three AC switches are used for powering the movable arm test head air heaters. The AC switches are located on the Heater Control Board (right-side of card cage). The AC switches are positioned on the board with corresponding indicator LED's as illustrated in figure 28.

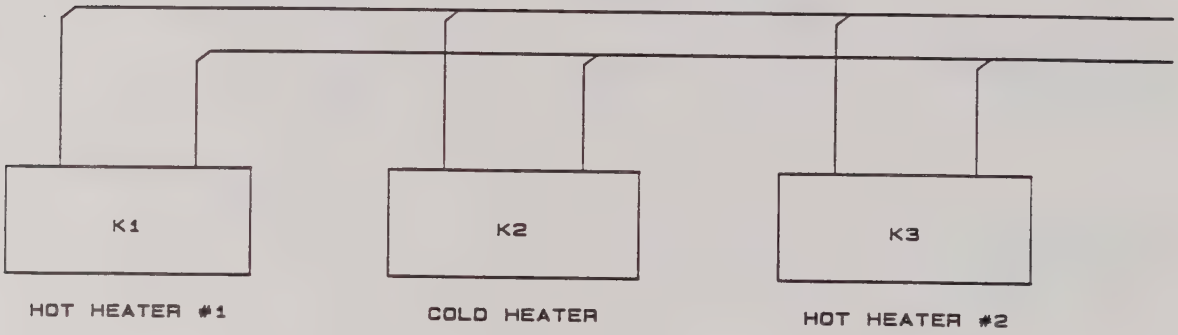


Figure 28.
AC Switches

Refer to section *AC Switch Trouble Shooting Procedure* for the AC switch checkout procedure.

Trouble Shooting the LN_2 Injection AC Switch

The LN_2 injection is optional and is only available on systems equipped with the movable arm. The LN_2 injection AC switch is located on the Boom Control Board. See figure 29.

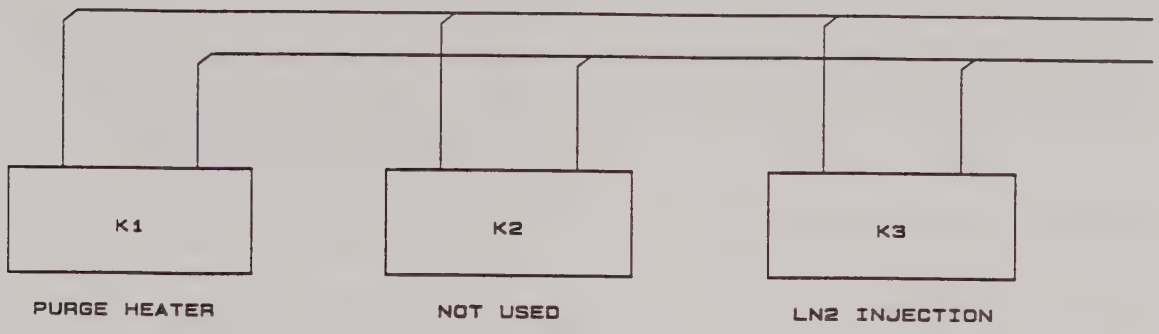


Figure 29.
Boom Control Board

Refer to section *AC Switch Trouble Shooting Procedure* for the AC switch checkout procedure.

TROUBLE SHOOTING THE HEATER THERMOSTATS IN THE TF-IC3 TEST HEAD

Three thermostats are located in the thermal test head, each attached to an air heater. The thermostats are wired in series and enter the PTFS rear panel through TEMP SENSOR 5 connector, pins 7 and 14. See figure 30.

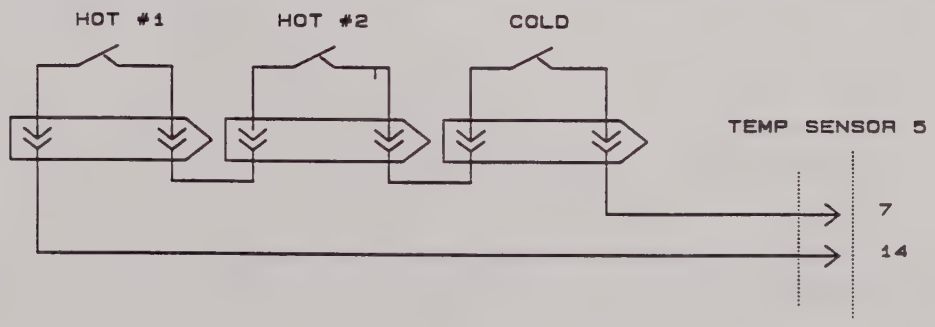


Figure 30.
Thermostat Connection Diagram

The system diagnostics will display the error message "Boom Failsafe Active" when a thermostat opens. The specific thermostat is not identified. Check continuity of the thermostats using an ohm meter at pins 7 and 14. If an open circuit is detected, the head assembly must be disassembled and each thermostat checked seperately. Refer to section, *Test Head Thermostat Replacement.*

TROUBLE SHOOTING THE COLD GAS DIVERTER VALVE

The operation of the cold air gas diverter can be checked by switching the gas flow from ambient to cold and back. When switched to ambient, a small amount of cold purge air will exit out the top vent of the test head assembly. No noticeable amount of air should be felt coming out the bottom. Switching to cold causes normal air flow out the bottom of the fixture and the cold purge air stops. If an appreciable amount of air flow is felt at the top of the fixture in the cold mode or at the bottom in the ambient mode, the diverter valve and linkage should be checked. Refer to section, *Test Head Disassembly.*

CORRECTIVE MAINTENANCE

Introduction

Corrective maintenance consists of component replacement, correction of loose connections and repair of damaged pneumatic lines. The procedures outlined below details the steps necessary to remove and replace the defective components. If the movable arm option is installed, refer to section, *Movable Arm and Thermal Fixture Disassembly.*

Obtaining Replacement Parts

All electrical and mechanical part replacements for the PTFS can be obtained through local Thermonics representatives or for quicker delivery, directly from Thermonics Inc.

When a part has been replaced by a new or improved part, the replacement will be accompanied by an explanation note and installation instructions, if necessary.

To ensure prompt and efficient handling of your order, include the following information.

1. Quantity
2. Thermonics Part Number
3. Description
4. Reference Designation (if one)
5. If non-standard parts are used (only if non-standard parts label is attached to rear panel).

Hot & Cold Air Heater Replacement

Both air heaters are located in a partitioned compartment, packed with refactory fiber. When servicing the heaters or heater thermostat, the refactory fiber must be manually removed and saved for later use (see Figure 29).

CAUTION

Working with the refactory fiber can cause temporary skin and upper respiratory irritation. Therefore, when handling this material:

1. **Wear gloves and eye protection.**
2. **Wash exposed skin areas with soap and warm water after handling.**

When replacing either heater, both heaters must be removed as one assembly. The defective heater replaced in the sub-assembly and the entire assembly re-installed. The heater removal procedure is as follows:

1. Disconnect the output hose(s) from the rear panel.
2. Unplug the power cord to the AC source.
3. Disconnect the hot (upper) heater from TB1-4 and K3 (see Figure 3.13).
4. Disconnect the cold heater from TB1-6 and K2.
5. Disconnect 2 Pin connector to hot heater thermostat.
6. Disconnect 2 Pin connector to cold heater thermostat.
7. Disconnect two yellow thermal couple plugs from merge block assembly.
8. Disconnect the molex connector to both heater thermostats.
9. Disconnect (by hand) the 3/8" teflon fitting from the cold heater input.
10. Remove 6 each screws from output gas plate. Remove gas plate and set aside.
11. Pull front panel off and with care set aside making sure not to put undue stress on the interconnect wiring.
12. Loosen 3/8" tube compression fitting between Venturi and heater cover block.
13. Remove heater compartment end plate.
14. Unplug thermocouple connectors to merge block.
15. Carefully lift the heater and merge block assembly out.
16. Replace defective heater and reverse the above procedure.

Thermostat Replacement

Thermostat replacement is a simple process only requiring the removal of the refactory fiber and simple removal from the heater case. However, care must be used in selecting the correct thermostat for the heater and proper positioning from the heater end. The correct procedure is as follows:

1. Determine which thermostat is defective using the procedure described in paragraph *Thermostat Trouble Shooting.*
2. Remove enough refactory fiber to fully expose the thermostat to be replaced. **Caution - observe the precaution described in paragraph** *Air Heater Replacement.*
3. Using a #21 Allen Head Driver, remove the two screws that secure the thermostat to the mounting bracket.
4. Discard the defective thermostat and install the replacement in the reverse procedure. See paragraph *Thermostat Trouble Shooting* for the correct thermostat replacement information.

Purge Heater Replacement (see figure 21)

The purge heater is removed as part of an assembly that includes, the purge regulator and thermocouple. The replacement procedure is as follows:

1. Unplug thermocouple from output of purge heater.
2. Disconnect both heater wires from TB1-2 and AC switch K1.
3. Disconnect thermostat molex connector.

Power Supply Replacement

The power supply is not a user repairable item and must be replaced with a new assembly. The unit may be returned to the original manufacturer for repair. The replacement procedure is as follows:

1. Disconnect connectors P1 and P2 on left side of power supply.
2. Remove four mounting screws.
3. Carefully lift assembly from chassis and replace with a new unit.

Air Solenoid Replacement

The air solenoid must be removed as part of an assembly that includes the regulator, the venturi and check valve. The replacement procedure is as follows:

1. Disconnect the 3/8" tubing at input to air solenoid.
2. Disconnect 1/8" tubing to venturi.
3. Disconnect slip-on lug to air solenoid.
4. If removing hot air solenoid assembly, disconnect fitting between venturi and heater cover block.
5. If removing cold air solenoid assembly, disconnect 3/8" tube air output to air solenoid.
6. Remove large plastic nut that secures regulator to the side panel.
7. Carefully lift assembly from chassis and replace air solenoid.
8. Re-install assembly using reverse procedure.

AC Switch Replacement

Access to three AC switches is limited and requires the removal of the Card Cage assembly with the Flow-Control board attached. The replacement procedure is as follows:

1. Remove four screws at the base of the card cage.
2. Disconnect flat cable connected to top of board in slot J1.
3. Disconnect cables to J1, J2 and J7 on the Flow-Control board.
4. Disconnect cables J5, J6, J7 and J10 on the mother board.
5. Disconnect three heater wires to TB-1.
6. Disconnect the thermocouple to the purge heater, the hot heater and the cold heater.
7. Disconnect the two brown wires to the purge heater pressure switch.
8. Disconnect the two 1/8" tubing connections at each venturi.
9. Carefully lift the entire card cage assembly from the chassis.
10. Remove the heater control board from the card cage after first removing the six screws that secure it to the side of the card cage.
11. Replace the defective AC switch and re-install the card cage assembly in the reverse procedure.

Refrigerant Recharge Procedure

1. Equipment and Supplies Required
   a. Cylinder of mixed refrigerant charge, part number L4-001.
   b. A Refrigeration Service Manifold Assembly, with pressure gauges and hoses.
   c. A small vacuum pump suitable for system evacuation.
   d. A cylinder of nitrogen gas and a pressure regulator (desirable, but not mandatory).
   e. A cylinder of "Freon-12" or "Freon-22".
   f. A halogen leak detector and a small amount of "Freon-12" (or Freon-22) for leak checking.

General

Prior to charging the system, it may be necessary to purge the refrigerant lines of any moisture or contamination they may have accumulated. This is particularly true if repairs to the refrigerant lines were made. If the refrigerant mixture is to be changed and no moisture in the refrigerant lines is suspected, then the moisture evacuation process can be bypassed.

The steps required to properly charge the system are:

1. Check refrigerant lines for leaks.
2. Evacuate the system (vacuum).
3. Blot out residual moisture using Freon-12 or dry nitrogen.
4. Charge the system with the pre-mixed refrigerant.

Connect the Refrigeration Service Manifold

1. Hang the gauge set from T-2420 near the compressor for convenient viewing.
2. Remove the seal cap from both the Suction Service Valve and the Discharge Service Valve. Remove the cover from the Suction Valve Stem.
3. Connect the hose from the blue gauge to the Suction Service Valve.
4. Connect the hose from the red gauge to the Discharge Service Valve.
5. Check that both service gauge valves are full clockwise.
6. Rotate suction valve at compressor clockwise two turns (away from back seating position). Suction Valve rotation is opposite that of conventional valves.

Leak Testing

1. Connect a canister of Freon-12 or Freon-22 to the center hose of the Service Manifold.
2. Open both Service Manifold valves and allow the system to pressurize to the canister pressure (usually 10-20 PSI).
3. Close both Service Manifold valves and disconnect the freon canister.
4. Connect the center hose to a dry nitrogen source (if available).
5. Open both Service Manifold valves and pressurize to 100 PSI.
6. Leak check all fittings, connections and lines with a quality halogen leak detector. In the absence of a leak detector, use soapy water.

Evacuation

1. Close both manifold valves and nitrogen cylinder valve. Disconnect hose.
2. Open manifold valves to allow the pressurized freon to escape.
3. Connect the vacuum pump to the center hose.
4. Open both manifold valves and turn vacuum pump on.
5. After the suction gauge (blue) displays 30 in., allow the system to evacuate for 30 minutes.
6. Turn both manifold valves off. Turn the vacuum pump off.

"Blotting" or "Sweeping" Cycle

1. Connect the nitrogen gas cylinder (with regulator) to the manifold hose.
2. Open suction manifold valve.
3. Adjust nitrogen regulator for the system to pressurize to 5-10 PSI. Freon-12 may be used if a nitrogen source is not available.
4. Allow the nitrogen (or Freon) to remain in the system for 10 to 15 minutes to blot up or sweep out any moisture remaining.
5. Repeat the Evacuation procedure described above, except for 4 hours or longer.

Charging the System

1. Connect the manifold center hose to cylinder of pre-mixed refrigerant.
2. Loosen the hose connection cut Suction Service Valve.
3. Briefly open the cylinder valve and then close. This purges the hose of any moisture accumulated.
4. Tighten hose connection at Suction Service Valve.
5. Close both manifold valves and fully open the cylinder valve. The Suction Service Valve should still be open at this time.
6. Fully open the manifold discharge valve (red), invert the cylinder and allow the contents to chain into the system.
7. When the system pressure and the cylinder pressure equalizes, close the manifold discharge valve and open the manifold suction valve.
8. Operate the compressor and close both the Manifold Suction Valve and Compressor Suction Valve when the measured vacuum reading is between 10 to 15 inches.
9. Disconnect service manifold hoses and replace Compressor Service Valve seal caps and compress Service Suction Valve cover.

Overload Protector Replacement

The overload protector is mounted on top of the compressor motor under a protective cover. The assembly can be accessed from the front of the system after removing the lower panel. The replacement procedure is as follows:

1. Remove lower front panel from T-2420.
2. Remove protective cover from top of compressor after first removing hold down spring clip. See figure 31.
3. Disconnect protector and discard. (See figure 32)
4. Install new protector.

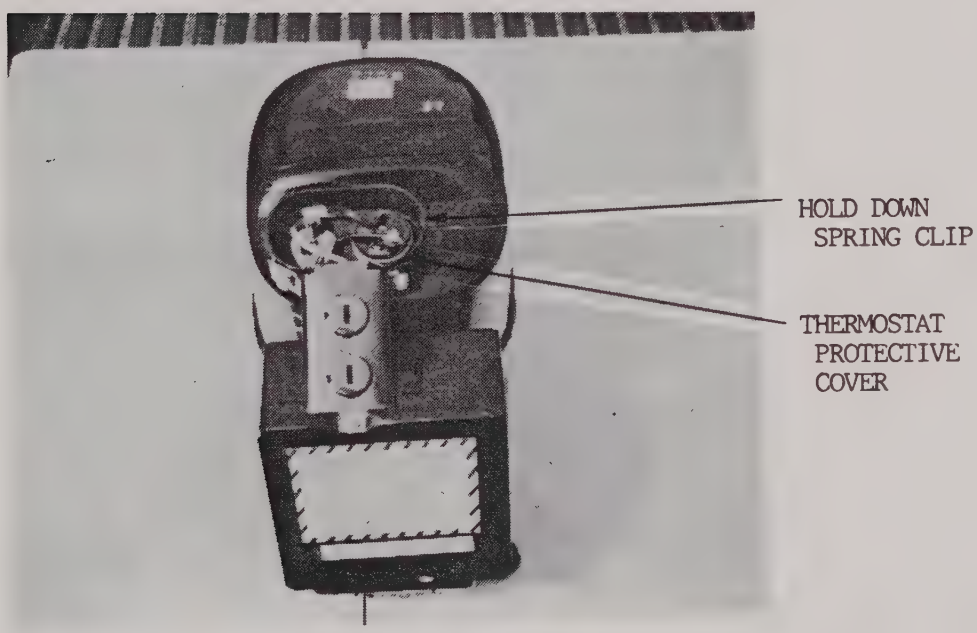


Figure 31.
Compressor

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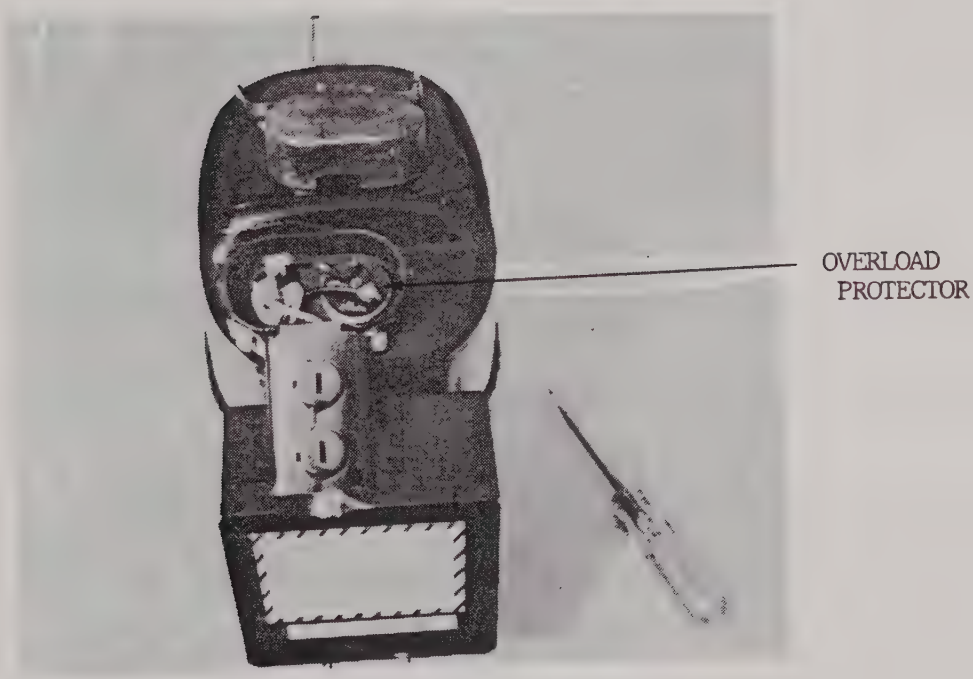

Figure 32.
Compressor With Overload Protector

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MOVABLE ARM OPTION

Movable Arm Test Head Disassembly

Disassemble of the movable arm test head is required to repair or replace any one of the following:

1. Hot or cold air heaters
2. Heater thermostat
3. Repair internal leaks
4. Adjust or replace cold air diverter valve

It is suggested that the following drawings are readily available during the disassembly and assembly procedure.

3F-100-1A	Boom System Assembly
3F-339-1A	Test Head Linear Bearing Mounting Assembly
3F-105-1A	Head Assembly

Movable Arm Disassembly Procedure

Position the system near a work bench and disconnect the air and power inputs. Disassemble the thermal test head as follows:

1. Remove the top and side access plate from the test head support bracket. See item (4) on drawing 3F-100-1A.
2. Disconnect the electrical connectors and tubing as follows:
   a). Cold air line - 3/8" white teflon tubing.
   b). Ambient air (hot heater) - 3/8" polyethelene tubing (black).
   c). Purge air line (hot) - 3/8" polyethelene tubing (white).
   d). Test head up/down air line, 2 ea. - 1/8" black polyurethane. Mark these lines with tape to insure that they are correctly re-installed.
   e). Diverter valve control, 2 ea. - 1/8" black polyurethane. *Mark these lines with tape to insure that they are correctly re-installed.*
   f). Temperature sensor - Yellow thermocouple connector.
   g). Up/down and brake release push-button connector - Six pin molex type connector.
   h). Heater thermostat - Two position molex type connector.
   i). Heater AC - Four position molex type connector.
3. Remove four screws from spiral hose support plate at top of test head fixture. See item 3 on assembly drawing 3F-339-1A.
4. Remove spiral hose to expose wires and tubing. Set aside.
5. Remove four screws that secure fixture top cover. See item 4 on assembly drawing 3F-339-1A.
6. Remove two scres that support air cylinder bracket to center backside of head assembly. See item 54 on assembly drawing 3F-105-1A.

7. While holding test head, remove four screws at bottom of assembly.
8. Slowly lower test head from housing. It may be necessary to rotate the assembly slightly as it is lowered. Set on table.
9. Remove test head shield from test head after first removing the three hold down screws. See item 8 on assembly drawing 3F-339-1A.

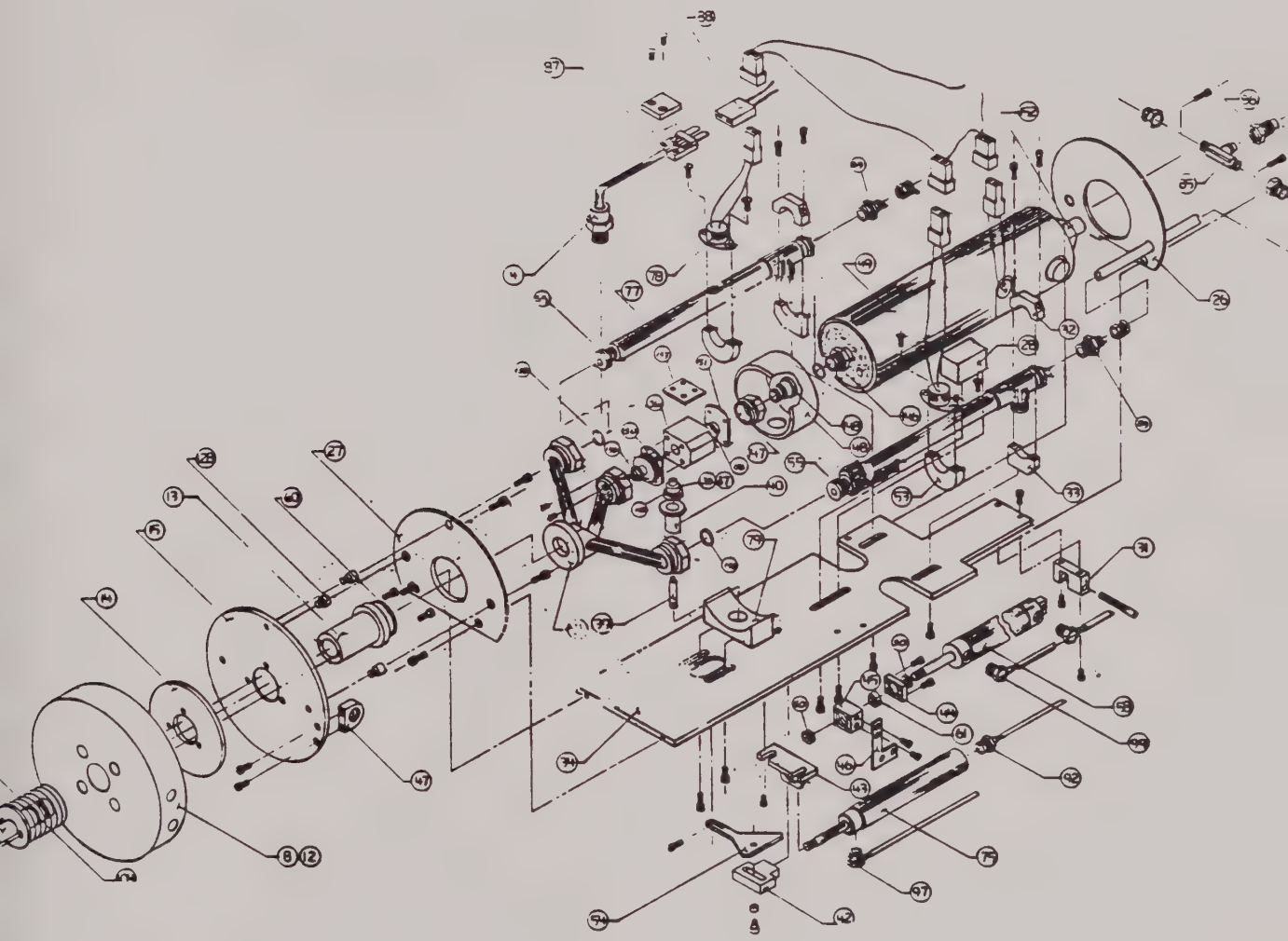

Figure 33.

Head Assembly, 3F-105-1A

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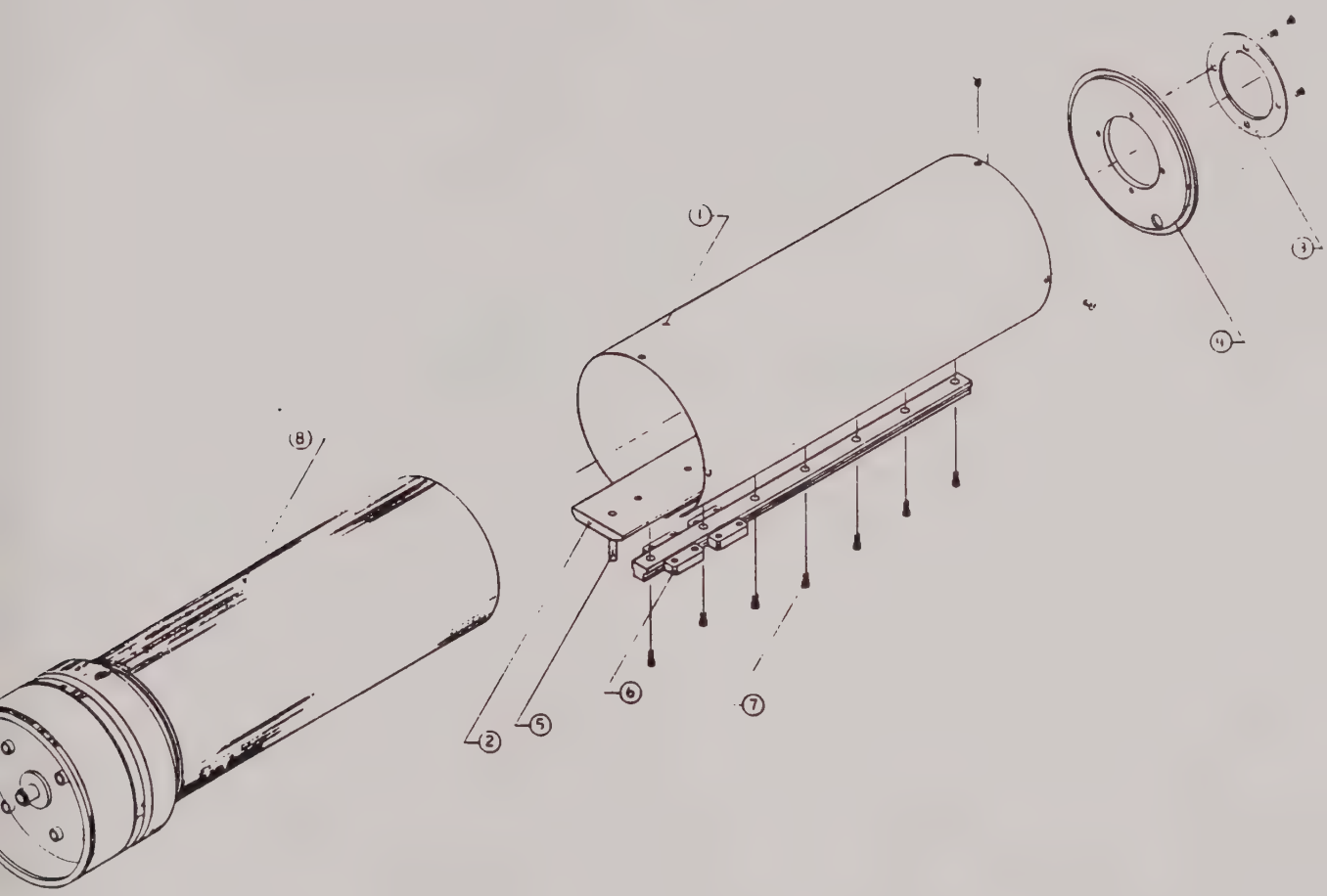

Figure 34.

Test Head and Linear Bearing Mounting Assembly

3F-339-1A

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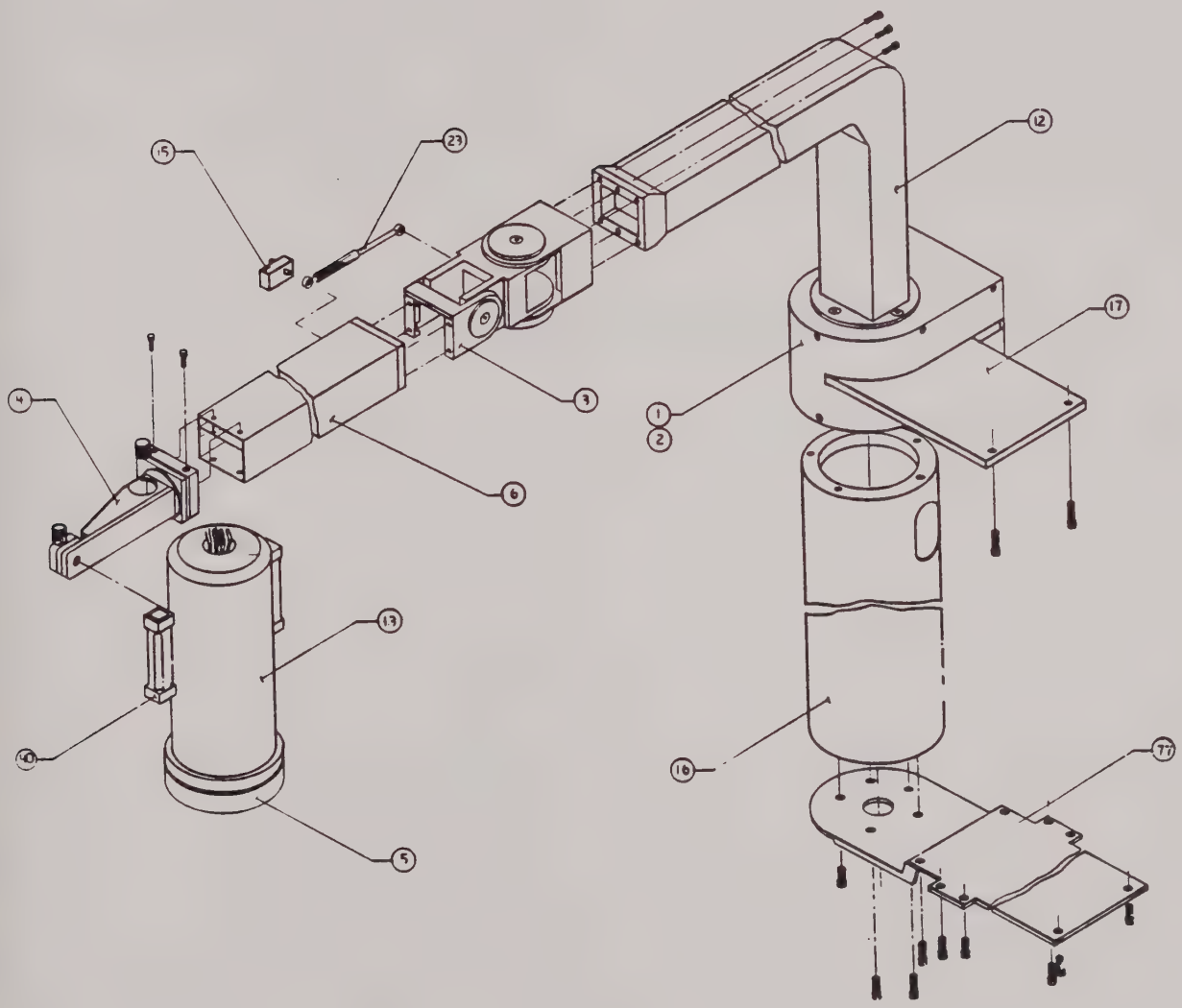

Figure 35.

Boom System Assembly, 3F-100-1A

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CALIBRATION

INTRODUCTION

This section describes both the automatic and manual calibration procedure. In both cases the temperature offset and scale values are computed based on the temperature loss between the hose sensor and the calibration sensor. The offset and scale value can then be stored in one of ten memory locations for recall at a later time.

Manual calibration consists of measuring the temperature of the environment in the near proximity of the DUT using an external temperature measurement device. The measured readings are then manually entered.

Automatic calibration requires no manual data entry. The PTFS measures the temperature using a packaged RTD and automatically computes and enters the calibration values.

Manual Calibration

The procedure for calibrating the PTFS manually is as follows:

1. Position the measurement device such as a RTD, thermocouple, thermistor or equivalent at the test socket and connect to the temperature meter. See figure for test setup.
2. Turn compressor ON and allow it to chill for approximately 20 minutes.
3. Set the air flow for 350 CFH or that required by the test fixture.
4. Press **AMB** push-button to place the PTFS in the stand by mode. The air flow to the fixture will stop.
5. Enter manual calibration mode by repeatedly pressing the **SET** key until the message "Manual Calibration" is displayed.
6. Press the **ENT** key and the system asks for the first Calibration point and displays the default value, -55^{o}C.
7. If the default value is acceptable, press **ENT** push-button, otherwise key in the new Calibration temperature and press **ENT**. Only values between -20^{o}C to -70^{o}C may be entered.

8. The PTFS then turns the air flow on and displays the temperature at the thermal fixture (TC) and the gas flow (F). The displayed flow will be 300 ±5 SCFH. Adjust the cold regulator as required.

   If the fixture connected requires a different gas flow then suggested above, adjust the cold gas flow regulator as required.

9. Allow a period of time for the gas temperature to stablize. The PTFS will ask the operator to key in the temperature measured by the secondary standard (Tcal).

10. Key in this temperature and momentarily press the **ENT** push-button.

11. The PTFS now asks for the second calibration temperature and displays the default temperature (125°C).

12. If the default temperature is acceptable, momentarily press the **ENT** push-button, otherwise enter the new temperature and momentarily press the **ENT** push-button. *Only temperature values between 70°C to 200°C may be entered.*

13. The PTFS then turns the gas flow on and displays the temperature at the thermal test fixture (TC) and the gas flow (F). The displayed flow will be 300 ±5 SCFH. Adjust the Hot regulator as required.

14. Allow a period of time for the gas temperature to stabilize. The PTFS will ask for the temperature measure by the external measurement device (Tcal).

15. Key in the measured temperature and press the **ENT** push-button.

16. The PTFS now computes the correct offset and scale factors and displays them for operator acceptance. The two values displayed are the scale factor K and the upper limit LIM. If these values are acceptable, press the **ENT** push-button, otherwise press any other key to abort the sequence.

Automatic Calibration

The procedure for Automatic Calibration is as follows:

1. Position the 1000 ohm RTD temperature sensor in the near proximity or in place of the DUT.

2. Connect the RTD sensor to the PTFS rear panel connector. See figure 36.

   If the temperature sensor 2 connector is currently being used, temperature sensor 1 can be used since both connectors are in parallel.

3. Press the **COMPRESSOR** push-button and allow 20 minutes for the heat exchanger to chill.

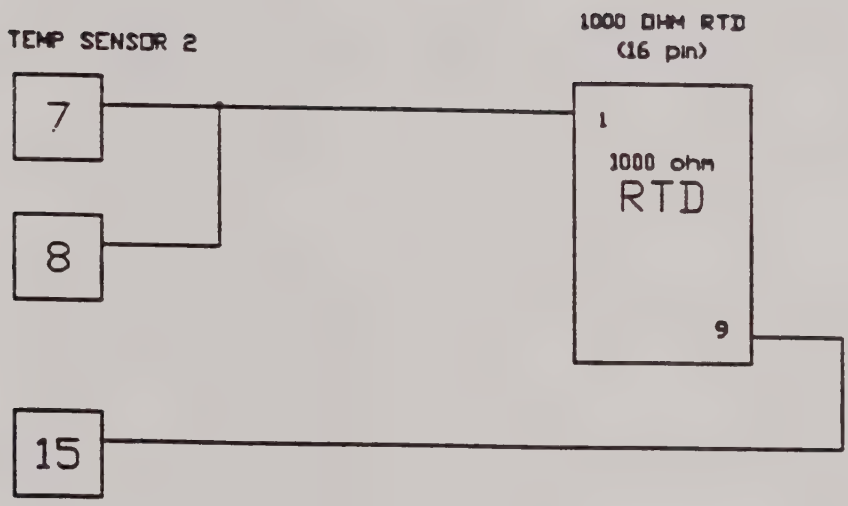

Figure 36.
CALIBRATION RTD
CONNECTION DIAGRAM (16 PIN RTD)

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4. Press the **COLD** push-button and observe that the air flow is 300 CFH. Adjust the **COLD** Flow-Control as required.

5. Momentarily press the **AMB** push-button. The air flow stops and the PTFS goes to stand by mode.

6. Select the Automatic Calibration mode by repeatedly pressing the **SET** key until Auto Calibration? is displayed.

7. Momentarily press the **ENT** key to select the Automatic Calibration mode.

8. The PTFS displays the default Hot calibration point, Tcal hot = 125?. If this value is acceptable press **ENT**, otherwise key in the new calibration temperature and momentarily press the **ENT** *push-button. Only temperatures from 70°C to 200°C may be entered.*

9. The PTFS now displays the default Cold calibration point, Tcal cold = -55?. If this value is acceptable, press **ENT**, otherwise key in the new calibration temperature and momentarily press the **ENT** push-button. *Only temperatures from -20°C to -70°C may be entered.*

10. The PTFS now displays the message Start Calibration?. Momentarily press the **ENT** key to start the calibration cycle. Press any other key to abort the sequence.

11. The PTFS now performs the automatic calibration cycle. The following steps will occur.

    a. The cold air turns on and the front panel displays the temperature, (TC) and (Tcal). (TC) is the measured temperature of the cold gas and (Tcal) is the measured temperature at the calibration sensor. After approximately 20 minutes and after the temperature has stabilized, the two temperatures are stored for later recall.

    b. The cold air automatically switches off and the hot air is turned on. The front panel again displays two temperatures. (TC) and (Tcal), where (TC) is the hot temperature measured at the fixture and (Tcal) is the temperature measured by the calibration sensor. After the temperature stabilizes, TC and Tcal are stored for later recall.

    c. The hot air now switches off and the cold air turns on and the temperature set point automatically sets to 0°C.

       The display shows two temperatures, (To) and (Tcal). (To) is the measured temperature at the fixture and (Tcal) is the temperature measured by the calibration sensor.

       After a period of time and after temperature stabilizes, the PTFS computes the scale factor and offset based on the hot and cold measurement.

    d. The display now shows the computed offset (To), and the scale factor K.

12. If the displayed offset and scale factor is acceptable, momentarily press the **ENT** key. Press any other key to abort the sequence.

    If the scale factor is outside the rage of 0.800 to 1.2000 or the offset is ±5.0°, then both entries have to be accepted individually.

ASSEMBLY DRAWINGS AND PART LISTS

INTRODUCTION

This section displays all assemblies and parts that make-up the T-2420.

ASSEMBLY INDEX

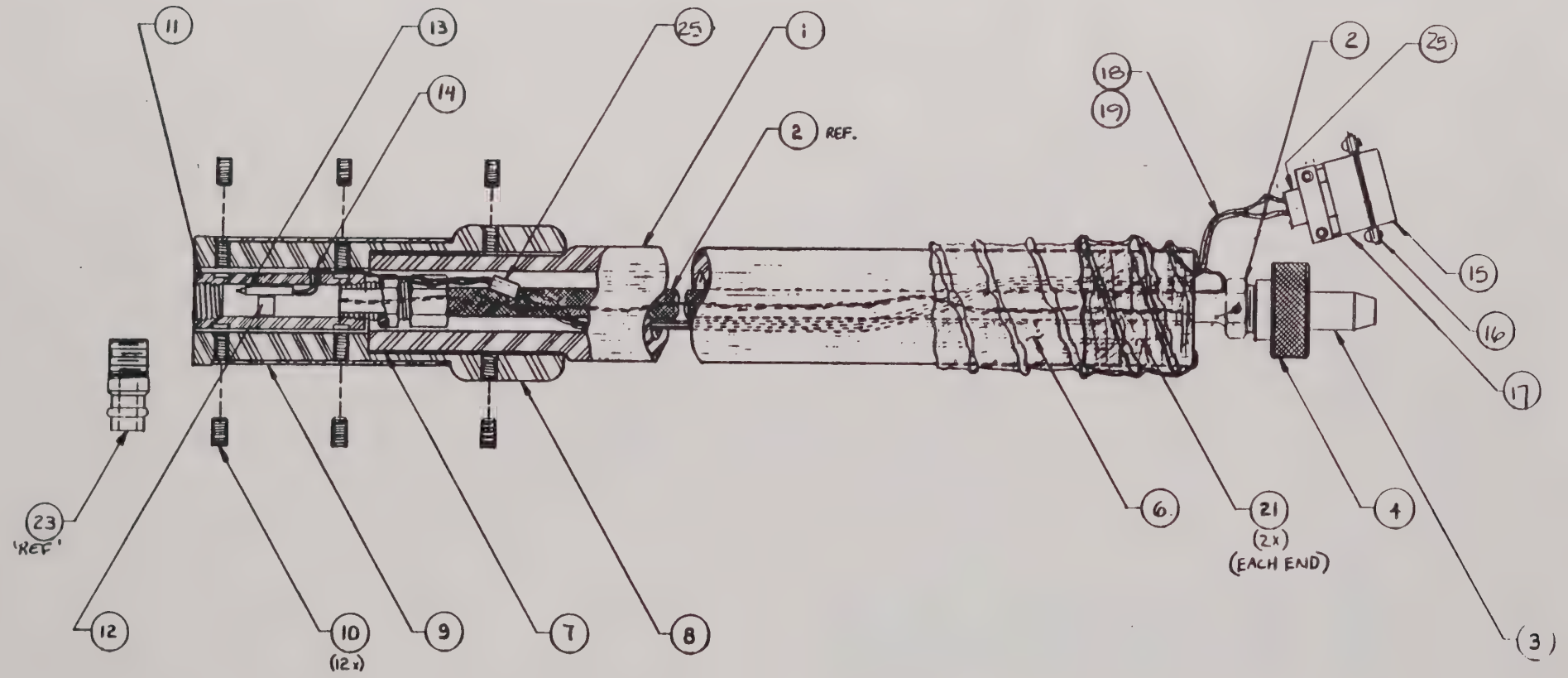
1A-037-1A	HOSE ASSEMBLY, 2420
1D-018-1A	AIR DRYER ASSEMBLY, PTFS, 2420
1D-023-1A	DESICCANT TANK SUB-ASSEMBLY
1D-031-1A	STREET ELBOW FILTER ASSEMBLY
1D-032-1A	ELBOW FILTER ASSEMBLY
1D-033-1A	HEX NIPPLE FILTER ASSEMBLY
1R-095-1A	T-2420 FRAME ASSEMBLY
1R-108-1A	PURGE HEATER ASSEMBLY, T-2420
1R-110-1A	REAR PANEL ASSEMBLY, T-2420
1R-114-1A	HOT HEATER ASSEMBLY, T-2420
1R-115-1A	COLD HEATER ASSEMBLY, T-2420
1R-117-1A	T-2420 CHASSIS ASSEMBLY
1R-149-1A	VALVE ASSEMBLY
1R-111-1A	FRONT PANEL ASSEMBLY, T-2420
1R-156-1A	THERMOCOUPLE ASSEMBLY
1R-205-1A	THERMOSTAT ASSEMBLY
1R-206-1A	THERMOSTAT ASSEMBLY WITH FEMALE CONNECTOR
1R-207-1A	THERMOCOUPLE ASSEMBLY
1R-208-1A	THERMOCOUPLE ASSEMBLY
1R-210-1A	THERMOSTAT ASSEMBLY, 350^{O}
3F-101-1A	REAR PIVOT BRAKE ASSEMBLY
3F-102-1A	REAR PIVOT ASSEMBLY
3F-103-1A	ELBOW AND BRAKE ASSEMBLY
3F-104-1A	HEAD BRACKET AND PIVOT ASSEMBLY
3F-106-1A	CUP ASSEMBLY
3F-338-1A	HEAD HANDLE ASSEMBLY

PART LIST 1A-037-1A

HOSE ASSEMBLY, T-2420

REFERENCE	PART NUMBER	DESCRIPTION
1	1L-001	INSULATION, TUBING, THERMOF
2	1F-328-1A	HOSE BRAIDED ASSEMBLY
3	1R-155-1D	TIP, VALVE ACTUATOR
4	1R-152-1D	NUT
6	P3-041	HOSE, DURAVENT, 2" OD
7	1F-280-1D	SLEEVE, SPONGE RUBBER HOSE
8	1F-281-1D	HANDLE, SENSOR HOUSING
9	1F-282-1D	HANDLE COVER, SENSOR HOUSING
10	H2-419	SET SCREW, S/S, 10-32 X 3
11	1F-279-1D	NOZZLE, SENSOR HOUSING
12	1F-150-1D	RTD RETAINER SPRING
13	1R-166-1C	SENSOR, RESISTANCE TEMPERATURE
15	C1-128	CONNECOTR, RECTANGULAR
16	H3-111	SCREW LOCKS, CANNON
17	H3-110	JUNCTION SHELL, METAL
18	W1-005	WIRE, BLACK, TEFLON
19	W1-007	WIRE, WHITE, TEFLON
21	1F-327-1A	TUBING, SHRING
23	1F-329-1D	NOZZLE, MALE THREADED

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INITIAL RELEASE 1749	9/5/85	
	B	ECN # 1762	9/13/85	
	C	BOM. UPDATE # 1765	9/19/85	
	D	ADDED BALLOONS 21, 22, 23, 24	2/17/86	1862 B
	E	UPDATE BACK TO MARCH BOM	6-26-86	1924
	F	REMOVE ITEM 24, TEFLON LINER, ITEM 29 SHEET ASSEMBLY HOSE CLAMP 26 & WIRE 20	11/10/86	1967



3. DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100%. DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.
2. SURFACE FINISH 125 MIN. UNLESS OTHERWISE SPECIFIED.
1. BREAK ALL SHARP CORNERS ON MACHINED PARTS .008 TO .015. REMOVE RAZOR EDGES ON SHEET METAL PARTS.

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

PARTS LIST

QTY REQD	FSCM NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

THERMONICS

HOSE ASSY. 2420

SIZE C | FSCM NO | DWG NO. 1A-037-1A | REV F

SCALE FULL | SHEET 1 OF 1

MATERIAL: SEE BOM.

FINISH

DRAWN: J.LYLES 9/17/86

CHECKED

ISSUED

APPROVALS | DATE

CONTRACT NO.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACTIONS ± 1/64, DECIMALS .XX ± .01, .XXX ± .005, ANGLES ± 1/2°

DO NOT SCALE DRAWING

NEXT ASSY | USED ON

APPLICATION

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PART LIST 1D-018-1A

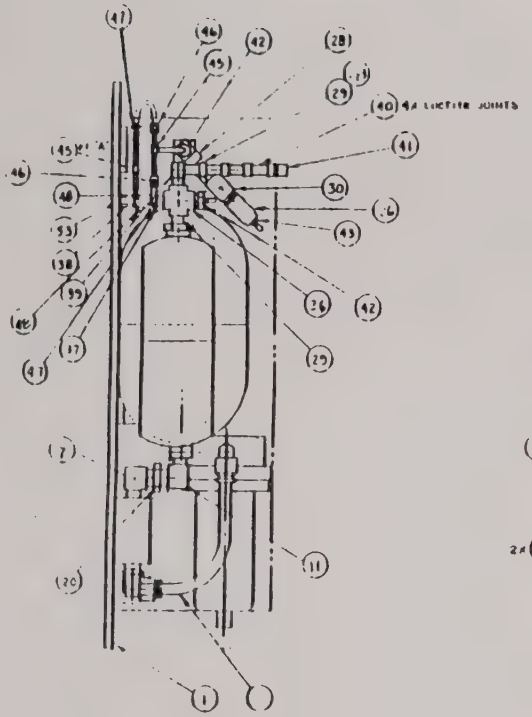
AIR DRYER ASSEMBLY, PTFS, T-2420

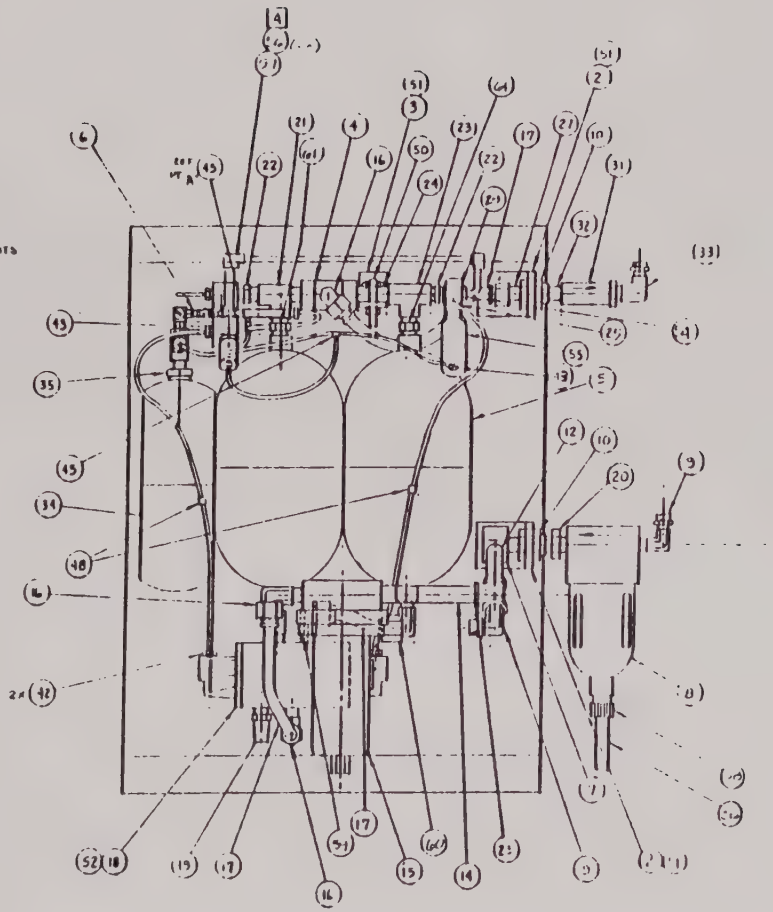
REFERENCE	PART NUMBER	DESCRIPTION
1	1D-019-1D	MOUNTING PLATE
2	1D-010-1D	BRACKET
3	1D-020-1D	PIPE HANGER
4	P1-053	SHUTTLE VALVE, 1/4 NPT
5	1D-023-1A	DESICCANT TANG SUB-ASSSEMBLY
6	1D-022-1A	HUMIDISTAT ASSEMBLY
7	P2-054	BRASS, STREET ELBOW
8	P5-006	FILTER, AIR - 20MU
9	P2-010	BRASS, ELBOW, 3/8 TUBE
10	P2-087	BRASS, CONNECTOR, ANCHOR
11	1D-031-1A	STREET, ELBOW, FILTER ASSY
12	P2-118	NIPPLE, 1/4 NPT X 2-1/2 LARGE
14	P2-120	NIPPLE, 1/4 NPT X 4"
15	P5-008	FILTER COALESCING, .01MV
16	P2-121	BRASS, ELBOW, 1/4 NPT X 3/8
17	P3-018	TUBING, PARAFLEX, BLACK
18	P1-034	VALVE, 4-WAY, 3 POSITION
19	P5-009	MUFFLER, SINTERED BRONZE
20	P2-055	BRASS, HEX NIPPLE, 1/4 NPT
21	P2-059	BRASS, STREET TEE, 1/4 MALE
22	P2-048	BRASS, BUSHING, 1/4 NPT
23	P2-122	BRASS, TEE, 1/4 NPT
24	P2-050	BRASS, LONG NIPPLE, 1/4 MALE
25	P1-035	VALVE, 3-WAY, N.C., 1/8 NPT
26	P1-018	ACTUATOR, PILOT MINI
27	P2-124	BRASS, MALE CONNECTOR
28	P2-125	BRASS, STREET TEE,1/8 NPT
29	P2-126	BRASS, CLOSE NIPPLE, 1/8
30	P1-036	VALVE, 3-WAY, N.O., 1/8 NPT
31	P5-010	FILTER, IN-LINE, 1/4 NPT
32	P2-127	BRASS, CLOSE NIPPLE, 1/4
33	P2-128	BRASS, ELBOW, 3/8 TUBE X 1/4
34	P5-011	TANK, 30CU", 2.50 OD
35	P2-136	BRASS, BUSHING, 1/2 NPT X 1/8
36	P2-129	BRASS, CROSS, 1/8 NPT
37	P2-029	BRASS, PIPE TO FEMALE ADAPTER
38	H3-114	STANDOFF, M-FM 10-32 X 3/8
39	P2-130	BRASS, "L" FITTING, 1/8
40	P2-081	BRASS, EXTENTION FITTING
41	P2-135	BRASS, ADJ. "L" FITTING
42	P2-131	PLASTIC, BARB FITTING, 1/16
43	P2-132	PLASTIC, BARB, 1/16 ID, TEFLON
45	P2-003	PLASTIC, T FOR USE WITH 1/16
46	P2-022	VALVE, CHECK, MINI
47	P1-037	RESTRICTOR, .007 ORIFICE
48	P1-038	RESTRICTOR, .006 ORIFICE
50	H2-325	"U" BOLT, 1/4" PIPE X 1/4
51	H2-159	SCREW, SHCS, S/S, 10-32
52	H2-217	SCREW, SHCS, S/S, 1/4 X 20

PART LIST 1D-018-1A

AIR DRYER ASSEMBLY, PTFS, T-2420

REFERENCE	PART NUMBER	DESCRIPTION
53	H2-223	SCREW, FHCS, S/S, 10-32 X 1
54	P2-168	BRASS, FITTING, 1/8 NPT
55	P1-044	ACTUATOR, SNAP ACTION #1
56	P3-015	TUBING, POLYURETHANE, 1/4
57	P2-005	PLASTIC, ELBOW, 90 DEG
58	P2-012	BRASS, MALE CONNECTOR
59	P2-152	BRASS, MALE ELBOW SWIVEL
60	1D-032-1A	ELBOW, FILTER ASSEMBLY
61	1D-033-1A	HEX, NIPPLE FILTER ASSEMBLY





[4] ITEMS (41) ARE USED FOR FLOW RESTRICTION

3 DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100%. DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.

2 SURFACE FINISH 125/MIN UNLESS OTHERWISE SPECIFIED.

1 BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .015 REMOVE RAZOR EDGES ON SHEET METAL PARTS.

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

THERMONICS

AIR DRYER ASSY

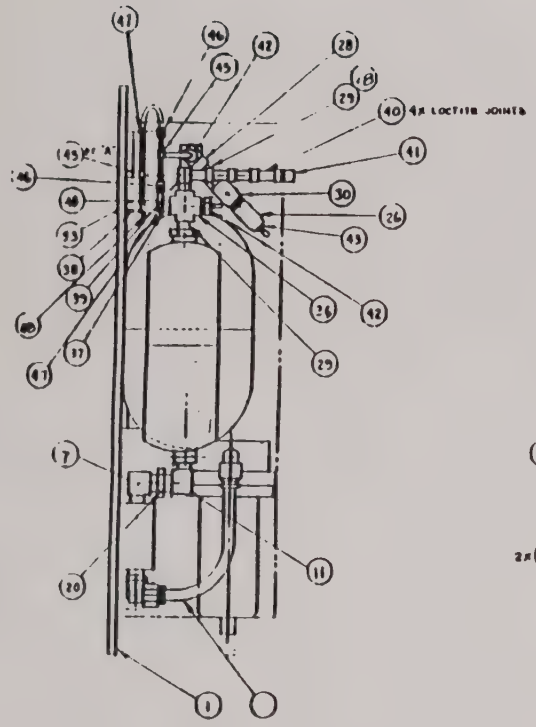
PTFS T-2420

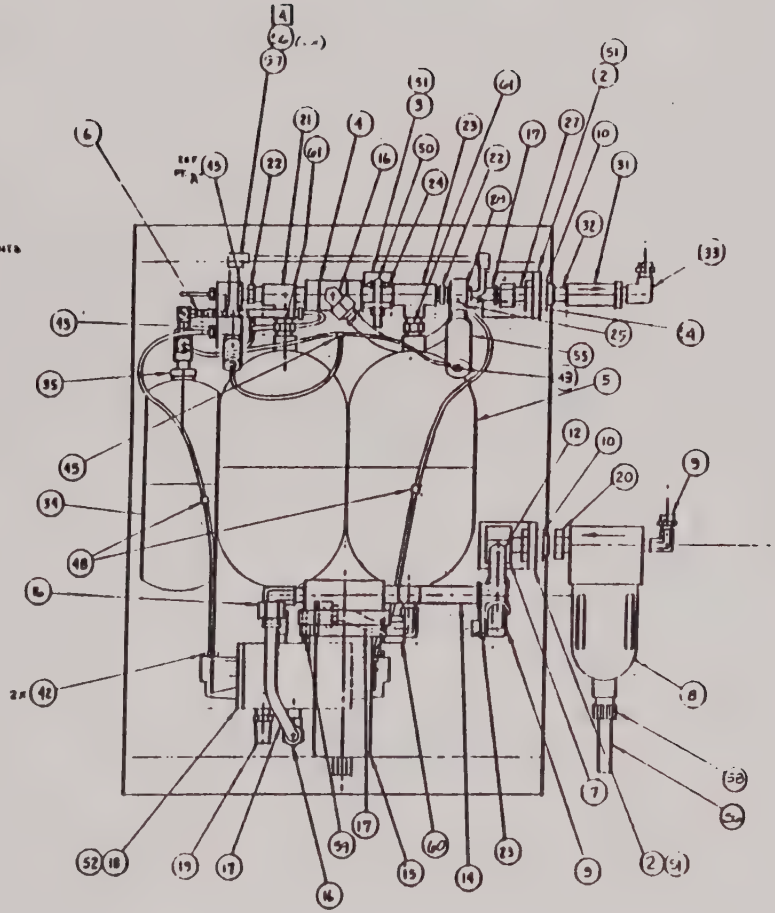
ID-018-1A

PART LIST 1D-023-1A

DESSICANT TANK SUB-ASSEMBLY

REFERENCE	PART NUMBER	DESCRIPTION
1	1D-026-1C	TANK
3	P5-015	MOLECULAR SIEVE, 4A-8-12





[4] ITEMS [24] ARE USED FOR FLOW RESTRICTION

3. DIMENSIONS UNDERLINED THUS WILL BE INSPECTED 100% DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.

2. SURFACE FINISH 125 MIN. UNLESS OTHERWISE SPECIFIED.

1. BREAK ALL SHARP CORNERS ON MACHINED PARTS .003 TO .015. REMOVE RAZOR EDGES ON SHEET METAL PARTS.

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

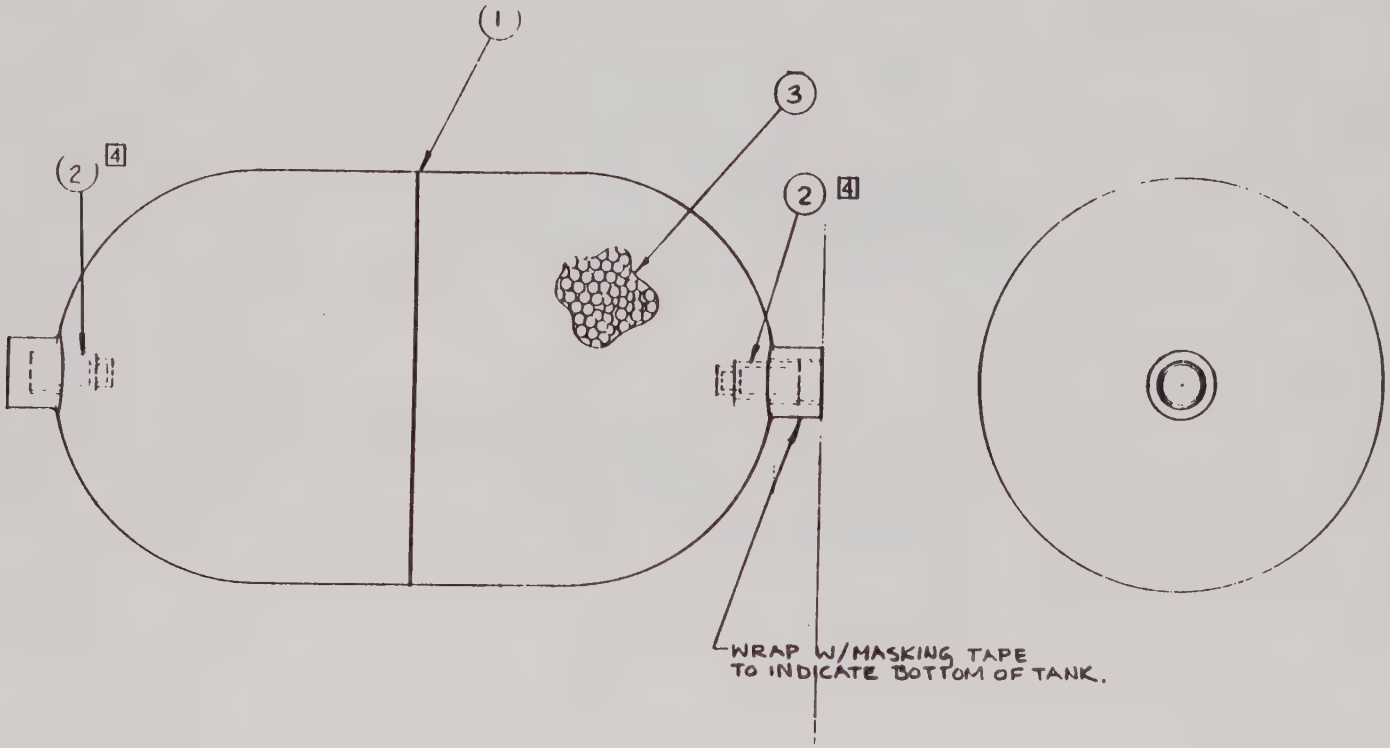
THERMONICS

AIR DRYER ASSY
PIFS T-2420

ID-018-1A

D

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	PRELIMINARY RELEASE	[illegible]	
	B	ECN # 1615	4-5-85	



. USE ANY MALE $\frac{1}{4}$ NPT NIPPLE OR FITTING TO PRESS FIT FILTER ELEMENTS IN PLACE, AFTER FILLING TANK W/DESSICANT.

DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100%
DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.

SURFACE FINISH 125 MIN. UNLESS OTHERWISE SPECIFIED

BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .015.
REMOVE RAZOR EDGES ON SHEET METAL PARTS.

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

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ID-025-1A		
ID-018-1A		
NEXT ASSY	USED ON	

APPLICATION

DO NOT SCALE DRAWING

QTY REQD	FSCM NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

CONTRACT NO

APPROVALS	DATE
DRAWN [illegible]	3-12-85
CHECKED	
ISSUED	

MATERIAL

FINISH

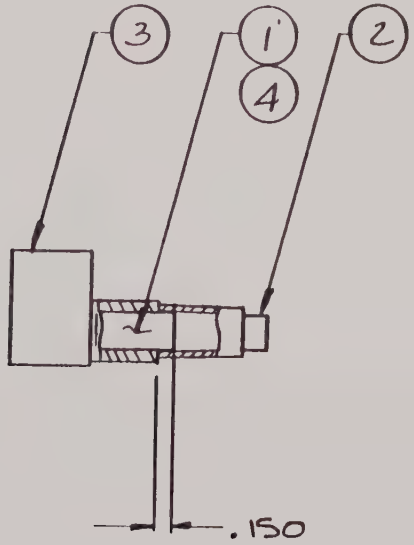
THERMONICS

DESSICANT TANK SUB-ASSY

SIZE C | FSCM NO | DWG NO ID-023-1A | REV B

SCALE 1/1 | SHEET 1 of 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	PROD REL., ECN 1759	9/11/85	



QTY REQD	FSCM NO	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± 1/64 | DECIMALS .XX ± .01, .XXX ± .005 | ANGLES ± 1/2°

MATERIAL

FINISH

CONTRACT NO

APPROVALS — DATE
DRAWN
CHECKED
ISSUED

THERMONICS

STREET ELBOW/FILTER ASSY

SIZE B | FSCM NO. | DWG. NO. ID-031-1A | REV. A

NEXT ASSY	USED ON
ID-025-1A	AIR DRYER

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3 DIMENSIONS UNDERLINED THUS WILL BE INSPECTED 100% DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION
2 SURFACE FINISH 125/ONE UNLESS OTHERWISE SPECIFIED
1 BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .015 REMOVE RAZOR EDGES ON SHEET METAL PARTS

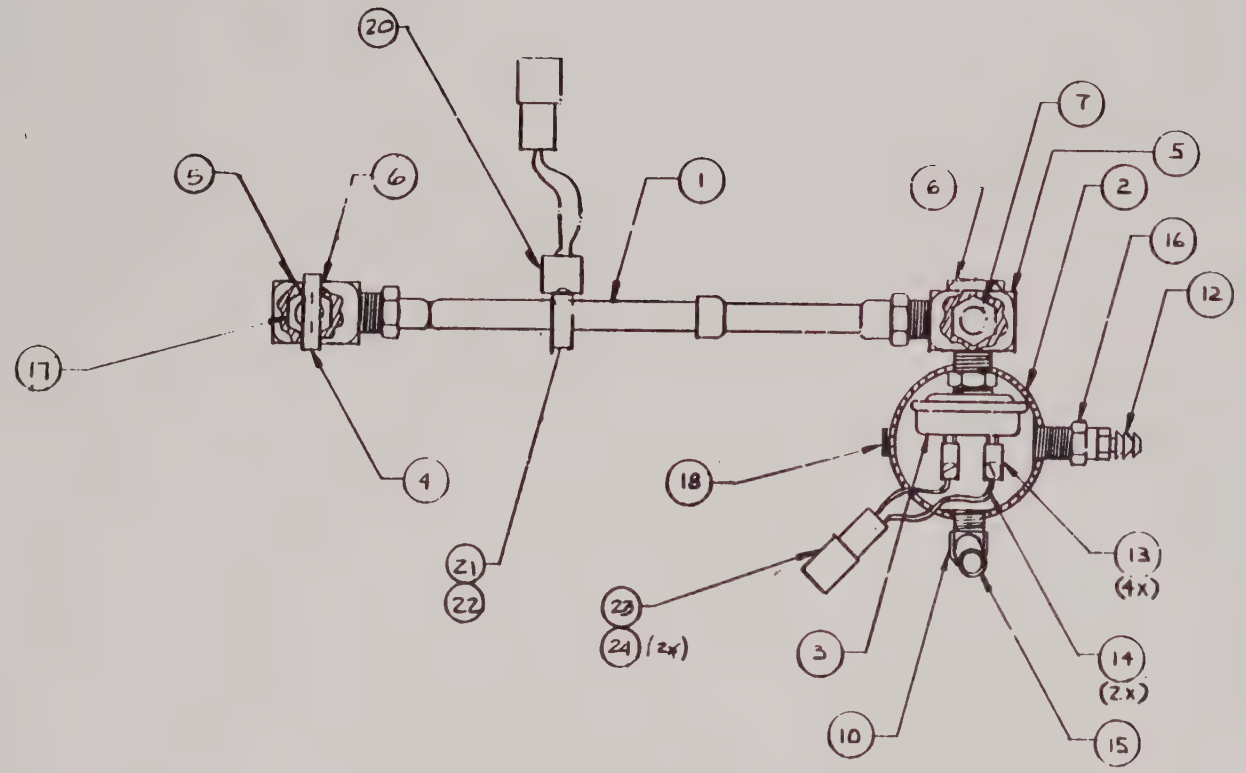
GENERAL NOTES (UNLESS OTHERWISE SPECIFIED)

PART LIST 1D-031-1A

STREET ELBOW FILTER ASSEMBLY

REFERENCE	PART NUMBER	DESCRIPTION
1	1D-030-1D	TUBE FILTER
2	P5-014	FILTER ELEMENT-SINTERED
3	1D-027-1A	STREET ELBOW, 1/4 NPT, MOD.
4	L1-004	ADHESIVE, STRUCTURAL TUBE

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	SEE ECN 1559	7/11/13	
	B	UPDATE, SEE ECN 1963	12/16/14	



3. DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100%. DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.
2. SURFACE FINISH 125 MIN. UNLESS OTHERWISE SPECIFIED.
1. BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .015. REMOVE RAZOR EDGES ON SHEET METAL PARTS.

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

PROPRIETARY INFORMATION

APPLICATION

DO NOT SCALE DRAWING

PARTS LIST

THERMONICS

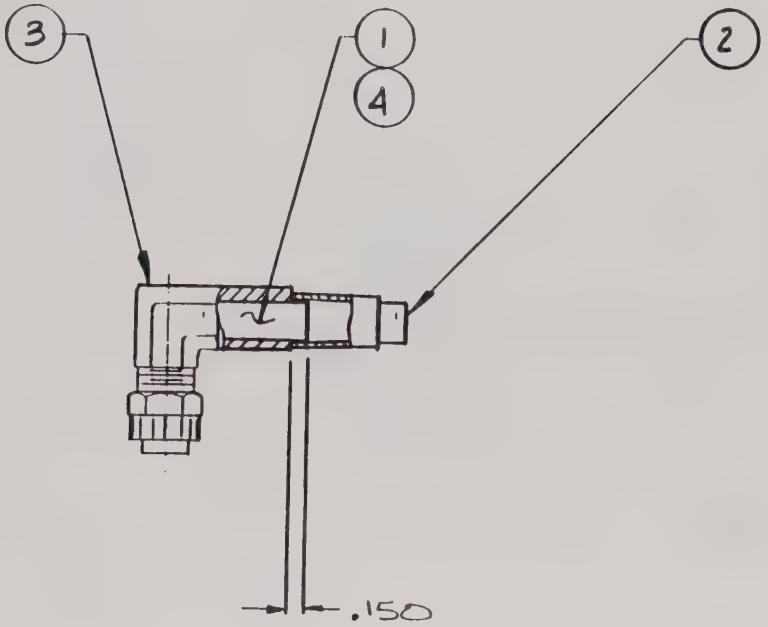
PURGE HEATER ASSY. 2420

SIZE	FSCM NO	DWG NO.	REV
C	1711	18-108-1A	B

SCALE 1/1 SHEET 1 OF 1

DRAWN J. LYLES 2/19/85

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	PROD. REL, ECN 1759	9/11/85	
B	CHANGED PICTURE OF ITEM 3 ECN #1869	2/19/86	



QTY REQD	FSCM NO	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION
			PARTS LIST	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ±1/64 DECIMALS .XX ± .01 .XXX ± .005 ANGLES ±1/2°

MATERIAL —

FINISH —

CONTRACT NO

APPROVALS — DRAWN Steph — DATE 9/11/85 — CHECKED — ISSUED

DO NOT SCALE DRAWING

THERMONICS

ELBOW/FILTER ASSY

SIZE B — FSCM NO. — DWG. NO. ID-032-1A — REV B

SCALE 1/1 — SHEET 1 OF 1

NEXT ASSY	USED ON
ID-025-1A	AIR DRYER

APPLICATION

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1. DIMENSIONS UNDERLINED THUS WILL BE INSPECTED 100% DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION
2. SURFACE FINISH 125/ RMS UNLESS OTHERWISE SPECIFIED
3. BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .015 REMOVE BURR OR SHARP EDGES ON SHEET METAL PARTS

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

PART LIST 1D-032-1A

ELBOW FILTER ASSEMBLY

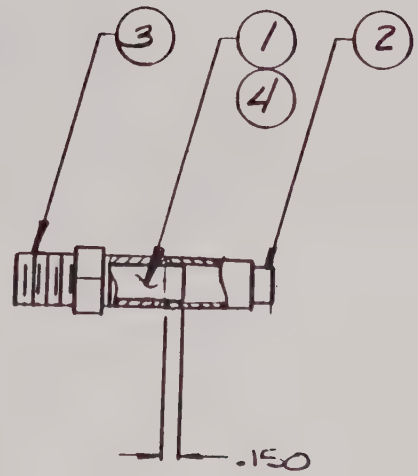
REFERENCE	PART NUMBER	DESCRIPTION
1	1D-030-1D	TUBE FILTER
2	P5-014	FILTER ELEMENT-SINTERED
3	1D-028-1A	ELBOW, 3/8 TUBE X 1/4 NPT
4	L1-004	ADHESIVE, STRUCTURAL TUBE

PART LIST 1D-033-1A

HEX NIPPLE FILTER ASSEMBLY

REFERENCE	PART NUMBER	DESCRIPTION
1	1D-030-1D	TUBE FILTER
2	P5-014	FILTER ELEMENT-SINTERED
3	1D-029-1A	HEX NIPPLE, MODIFIED
4	L1-004	ADHESIVE, STRUCTURAL TUBE

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	Prod Rel, ECN 1759	9/11/05	



QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION
			PARTS LIST	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± 1/64 | DECIMALS .XX ± .01 .XXX ± .005 | ANGLES ± 1/2°

MATERIAL

FINISH

CONTRACT NO.

APPROVALS | DATE

DRAWN Cyrk 9/11/05

CHECKED

ISSUED

THERMONICS

HEX NIPPLE/ FILTER ASSY

SIZE B | FSCM NO. | DWG. NO. ID-033-1A | REV. A

SCALE 1/1 | SHEET 1 OF 1

DO NOT SCALE DRAWING

APPLICATION

NEXT ASSY	USED ON
D-025-1A	Air Dryer

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2. DIMENSIONS UNDERLINED THUS ___ WILL BE INSPECTED 100%. DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION
3. SURFACE FINISH 125/ RMS UNLESS OTHERWISE SPECIFIED
4. BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .010 RADIUS AND/OR .030 ON SHEET METAL PARTS.

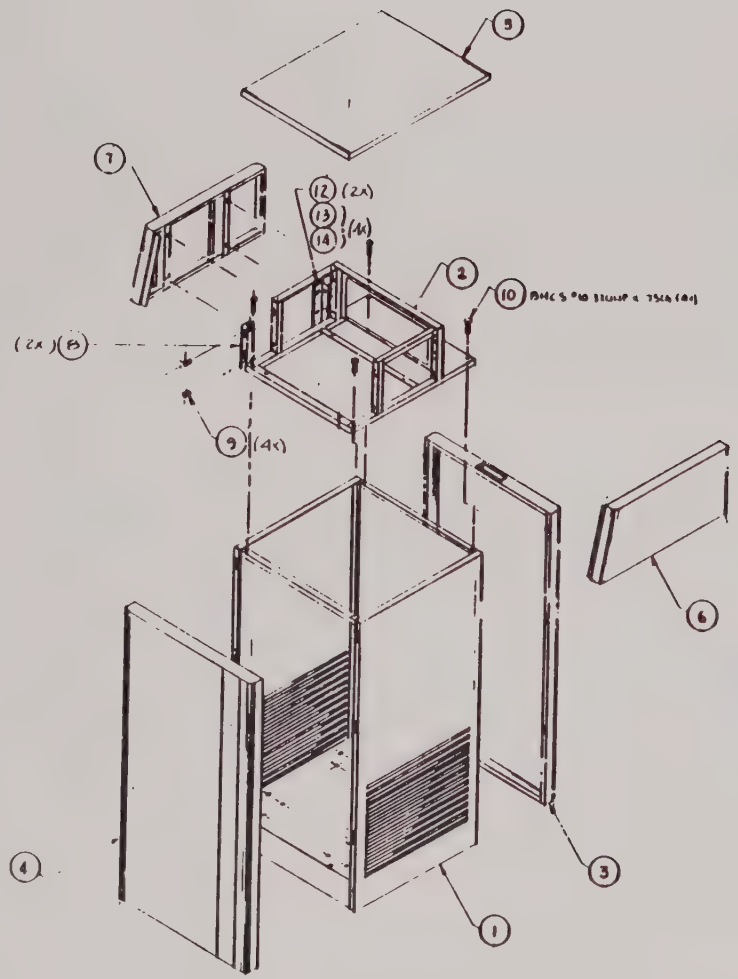
GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

PART LIST 1R-095-1A

FRAME ASSEMBLY, T-2420

REFERENCE	PART NUMBER	DESCRIPTION
1	1R-099-1D	FRAME WELDMENT
2	1R-096-1D	FRAME WELDMENT, CHASSIS
3	1R-101-1D	PANEL, REAR
4	1R-100-1D	PANEL, FRAME FRONT
5	1R-102-1D	COVER, TOP
6	1R-097-1D	PANEL SIDE, CHASSIS
7	1R-097-2D	PANEL SIDE, CHASSIS
8	1R-098-1D	BRACKET, SIDE COVER MOUNT
9	H2-159	SCREW, SHCS, S/S, 6-32 X 3/8
10	H2-270	SCREW, BHCS, S/S, 10-32
11	1R-159-1A	DRAWER PULL, PAINTED, MOD.
12	1R-170-1D	BRACKET, SIDE COVER MOUNT
13	H2-151	SCREW, SHCS, S/S, 6-32 X 1/4
14	H2-031	SCREW, SHCS, S/S, 6-32 X 3/4
15	1R-209-1D	NUT

REV	DESCRIPTION	DATE
A	RELEASE FOR PRODUCTION	
B	Update Dwg, Ecn 1721	11/13/84



CONFIDENTIAL INFORMATION			
APPLICATION			
DO NOT SCALE DRAWING			

PARTS LIST

THERMONICS

FRAME ASSEMBLY
PTFS 2420

D | IR-095-1A | B

PART LIST 1R-108-1A

PURGE HEATER ASSEMBLY, T-2420

REFERENCE	PART NUMBER	DESCRIPTION
1	K2-002	HEATER, PURGE, 300W, 240V
2	P1-016	REGULATOR, PRESSURE, 1/4
3	X1-009	SWITCH, LOW PRESSURE
4	1R-156-1A	THERMOCOUPLE ASSEMBLY
5	1R-037-1A	BRASS, PIPE ELBOW, MODIFIED
6	P2-054	BRASS, STREET ELBOW, 1/4
7	P2-127	BRASS, HEX NIPPLE, 1/4 MNPT
10	P2-078	BRASS, M-ELBOW, 1/4 TUBE
12	P2-023	BRASS, HOSE FITTING, 10-32
13	C1-100	TERMINAL, RING LUG, 3M
14	W1-016	WIRE, BROWN, 22 GA STRAND
15	P3-017	TUBING, PARAFLEX, BLACK
16	P2-029	BRASS, PIPE TO FEMALE ADAPTER
17	P2-013	BRASS, TUBE END MALE ADAPTER
18	P2-061	STEEL, HEX SOCKET PLUG
19	1R-021-1A	BRASS, PIPE ELBOW, MODIFIED
20	1R-205-1A	THERMOCOUPLE ASSEMBLY
23	C1-003	CONNECTOR, 2 PIN
24	C1-002	TERMINAL

PART LIST 1R-110-1A

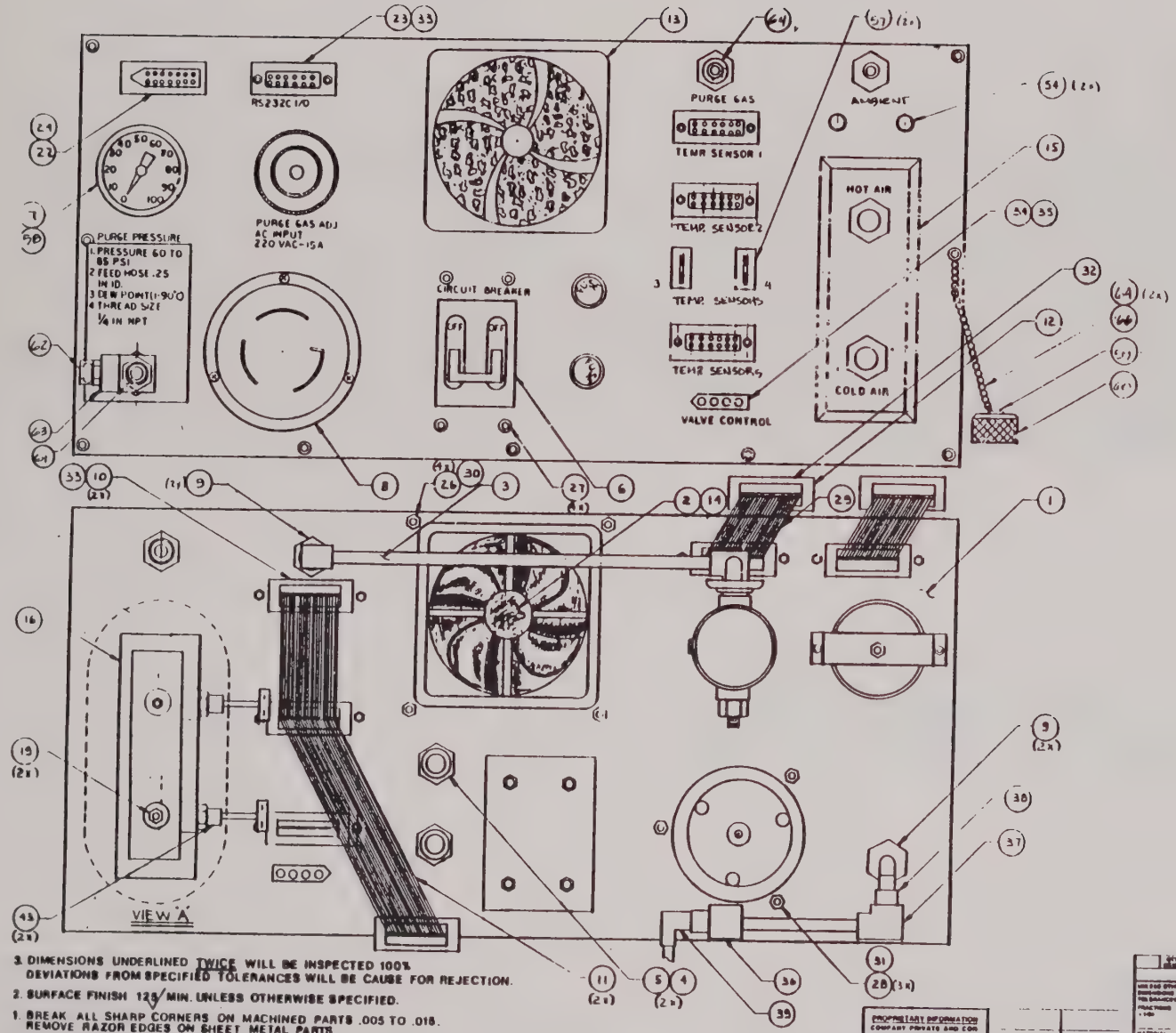
REAR PANEL ASSEMBLY, T-2420

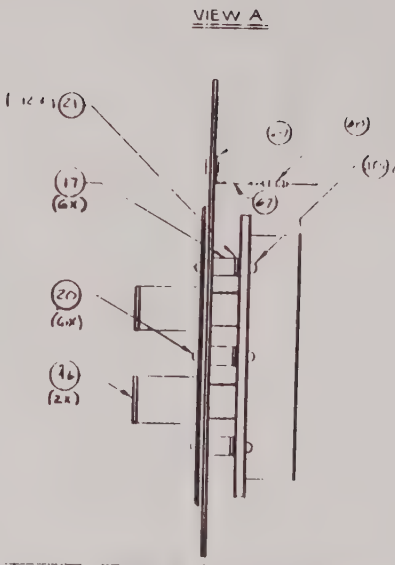
REFERENCE	PART NUMBER	DESCRIPTION
1	1R-056-1D	PANEL, REAR, T-2420
2	F4-004	FAN, 230 VAC, 60 HZ
3	1R-108-1A	PURGE HEATER ASSEMBLY
4	X1-026	FUSE HOLDER, BUSS, 30 A
5	X1-043	FUSE, 250V, 2 AMP, SLOW BLO
6	X1-036	CIRCUIT BREAKER, 20A, 250V
7	P1-006	PRESSURE GAUGE, 100 PSI
8	C1-094	CONNECTOR, AC, INPUT FEMALE
9	1S-021-A	BRASS, FEMALE BULKHEAD
10	C1-168	CONNECTOR, RIBBON TYPE D
11	W1-033	CABLE, FLAT-HITACHI, 16
12	C1-099	CONNECTOR, 16 PIN, FLAT
13	F5-002	FAN ACCESS, FAN GUARD
15	1R-092-1D	DRESS COVER
16	1R-200-1D	BLOCK, GAS JUNCTION
17	H3-231	STANDOFF, CERAMIC
18	H2-067	SCREW, BHCS, S/S, 4-40 X 1/4
19	P2-055	BRASS, HEX NIPPLE, 1/4 MNPT
20	H2-020	SCREW, BHCS, 4-40 X 1/2
21	H2-127	WASHER, S/S, #6,
22	C1-035	CONNECTOR, 24 PIN, AMP
23	C1-169	CONNECTOR, RIBBON, TYPE D
24	H2-288	HARDWARE KIT, PANEL MOUNT
26	H2-026	SCREW, BHCS, S/S, 6-32 X 3/8
27	H2-079	SCREW, BHCS, S/S, 6-32 X 1/4
28	H2-132	SCREW, BHCS, S/S, 10-32
29	W1-030	CABLE, FLAT-HITACHI, 26
30	H2-186	NUT, HEX, S/S, 6-32
31	H2-057	NUT, HEX, S/S, 10-32
32	C1-098	CONNECTOR, 26 PIN, FLAT
33	H2-289	HARDWARE KIT, CONNECTOR
34	C1-014	CONNECTOR, MOLEX, LARGE
35	C1-016	TERMINAL, .093 FEMALE
36	P1-007	VALVE, AIR, SOLENOID, 120
37	P2-058	BRASS, ELBOW, 1/4 FNPT
38	P2-013	BRASS, TUBE END MALE ADAPTER
39	P2-010	BRASS, ELBOW, 3/8 TUBE
40	W1-045	CABLE, FLAT, 24 CONDUCTOR
43	1R-156-1A	THERMOCOUPLE ASSEMBLY
46	C1-127	CONNECTOR, RECTANGULAR
48	H3-110	JUNCTION SHELL, METAL
49	H3-111	SCREW, LOCKS
50	1R-149-1A	VALVE ASSEMBLY
51	H3-144	JUNCTION SHELL, METAL
52	H2-392	HARDWARE KIT, D TYPE
54	C1-192	JACK, BANANA
57	T1-019	JACK, MINATURE PANEL
60	1R-221-1D	CAP, AIR OUTLET
61	P2-181	COUPLER, PLUG QUICK CONNECT

PART LIST 1R-110-1A

REAR PANEL ASSEMBLY, T-2420

REFERENCE	PART NUMBER	DESCRIPTION
62	P2-182	COUPLER, BODY
63	P2-059	BRASS, STREET T
64	H3-041	EYELET
65	P2-205	BRASS, PUSH CONNECTOR
66	H3-040	CHAIN





3. DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100%. DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.

2. SURFACE FINISH 125 MIN. UNLESS OTHERWISE SPECIFIED.

1. BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .018. REMOVE RAZOR EDGES ON SHEET METAL PARTS.

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

REV	DESCRIPTION	DATE
A	INITIAL RELEASE, ECN 1559	1/4/89
B	ADD BALLOON - S4	7/7/89
C	PER ECN 1603	12/11/91
D	SEE ECN 1980	3/21/03

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PARTS LIST

SEE BOM.

DO NOT SCALE DRAWING

THERMONICS

REAR PANEL ASSY.24

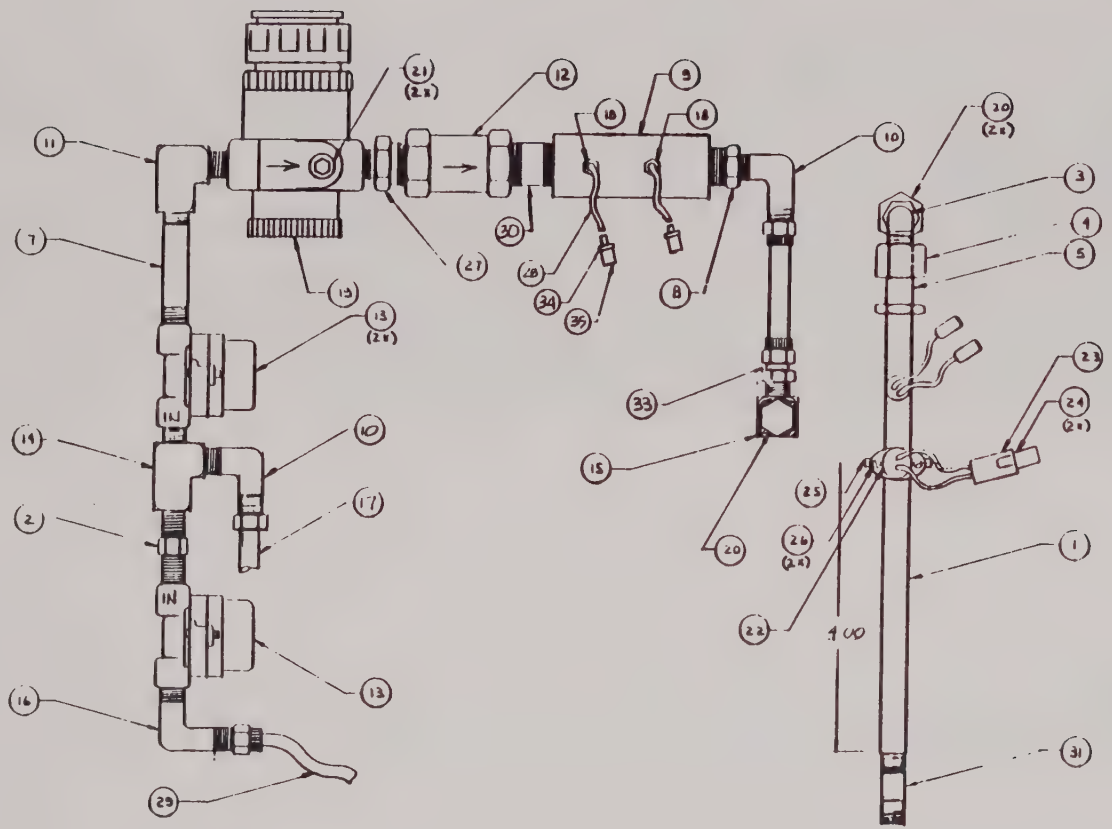
IR-110-1A

PART LIST 1R-114-1A

HOT HEATER ASSEMBLY, T-2420

REFERENCE	PART NUMBER	DESCRIPTION
1	K1-009	HEATER, AIR, 1000W, 240V
2	P1-007	VALVE, AIR, SOLENOID, 120
3	1R-158-1A	REGULATOR, PAINTED, MODIFIED
4	3S-026-1D	VENTURI, T-2075V, T-2400R
5	P2-054	BRASS, STREET ELBOW, 1/4
6	P2-010	BRASS, ELBOW, 3/8 TUBE
7	P2-013	BRASS, TUBE END MALE ADAPTER
8	P2-127	BRASS, CLOSE NIPPLE, 1/4
9	P2-139	BRASS, CLOSE NIPPLE, 1/2
10	P2-097	PLUG, HEX HEAD, COUNTERSUNK
11	P2-023	BRASS, HOSE FITTING, 10-32
12	1R-066-1D	ELBOW FITTING OFFSET
13	P2-050	BRASS, LONG NIPPLE, 1/4 MALE
14	C1-050	LUG, BLOCK SPADE, RED
15	1S-205-1A	THERMOSTAT ASSEMBLY, 160 DEG
16	C1-047	LUG, SLIP-ON, SMALL, FEMALE
18	1R-029-1D	BRACKET, THERMOSTAT
19	H2-067	SCREW, BHCS, S/S, 4-40 X 1/4
20	P2-140	BRASS, REDUCING NIPPLE
21	P2-046	BRASS, MALE CONNECTOR, 3/8
22	P1-040	BRASS, CHECK VALVE, 1/2 FEMALE
23	1R-157-1D	COVER, REGUALTOR KNOB
24	P2-002	PLASTIC, BARB, CONNECTOR
25	P3-015	TUBING, POLYURETHANE, 1/4
26	P3-016	TUBING, POLYURETHANE, 1/8

ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	SEE ECN 1589	2/6/85	
	B	PER ECN 1627	7/10/85	
	C	DIM CHANGE 4.00 MIN. TO 3.25	9/20/85	
	D	ADD ITEM 31, ADD AN ASSEMBLY NOTE	6-24-86	



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1. BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .015. REMOVE RAZOR EDGES ON SHEET METAL PARTS.

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

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J.LYLES 2/12/85

THERMONICS

HEATER ASSY. COLD 2420

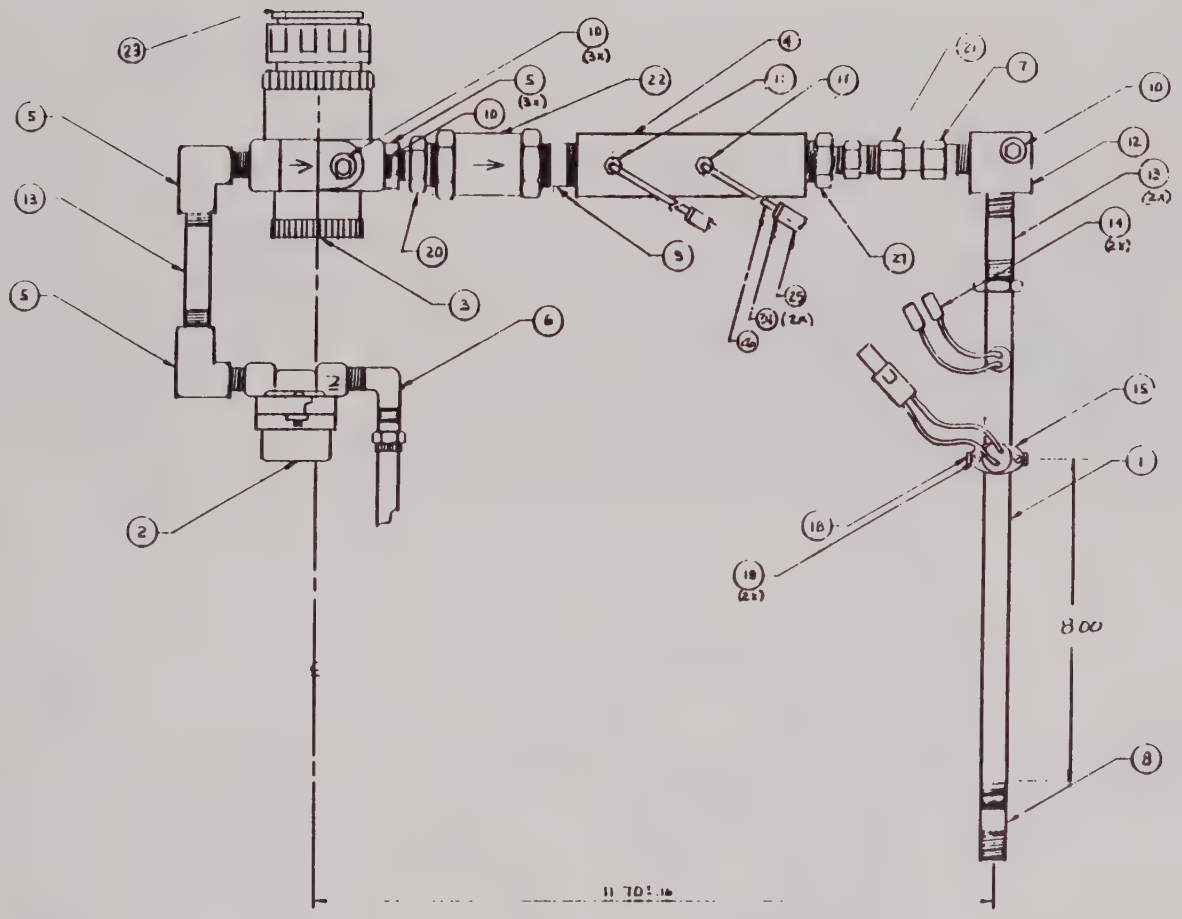
SIZE D | DWG NO 1R-115-1A | REV D

SCALE | SHEET

PART LIST 1R-115-1A

COLD HEATER ASSEMBLY, T-2420

REFERENCE	PART NUMBER	DESCRIPTION
1	K1-003	HEATER, AIR, 600W, 240V
2	P2-055	BRASS, HEX NIPPLE, 1/4 MNPT
3	P2-095	ELBOW, FEMALE CONNECTOR
4	P2-041	PLASTIC, MALE CONNECTOR
5	P3-011	TUBING, TEFLON, 3/8 OD
6	P2-047	BRASS, ADAPTER, 1/4 FNPT
7	P2-051	BRASS, LONG NIPPLE, 1/4 MALE
8	P2-049	BRASS, BUSHING, 1/2 MNPT
9	3S-026-1D	VENTURI, T-2075V, T-2400R
10	P2-010	BRASS, ELBOW, 3/8 TUBING
11	P2-054	BRASS, STREET ELBOW, 1/4
12	P1-040	BRASS, CHECK VALVE, 1/2 FEMALE
13	P1-007	VALVE, AIR, SOLENOID, 120V
14	P2-059	BRASS, STREET TEE, 1/4 MALE
15	P2-058	BRASS, ELBOW, 1/4 FNPT
16	P2-078	BRASS, MALE ELBOW, 1/4
17	P3-018	TUBING, PARAFLEX, BLACK
18	P2-023	BRASS, HOSE FITTING, 10-32
19	1R-158-1A	REGULAOTR, PAINTED, MODIFIED
20	P2-046	BRASS, MALE CONNECTOR, 3/8
21	P2-097	PLUG, HEX HEAD, COUNTERSUNK
22	1S-210-1A	THERMOSTAT ASSEMBLY, 210 DEG
25	1R-029-1D	BRACKET, THERMOSTAT
26	H2-067	SCREW, BHCS, S/S, 4-40 X 1/4
27	P2-140	BRASS, REDUCTING NIPPLE
28	P3-016	TUBING, POLYURETHANE, 1/8
29	P3-017	TUBING, PARAFLEX, BLACK
30	P2-139	BRASS, CLOSE NIPPLE, 1/2
31	P2-127	BRASS, CLOSE NIPPLE, 1/4
32	1R-157-1D	COVER, REGULATOR KNOB
33	P2-011	BRASS, MALE CONNECTOR, 3/8
34	P2-002	PLASTIC, BARB CONNECTOR
35	P3-015	TUBING, POLYURETHANE, 1/4
36	C1-050	LUG, BLOCK SPADE, RED
37	C1-047	LUG, SLIP-ON, SMALL, FEMALE



ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	SEE ECN 1559	7/19/77	
	B	PER ECN 1677	7/28/77	
	C	DIM CHANGE B 4.00 was 7.00	9/16/77	9/26/77
	D	[illegible]	[illegible]	[illegible]

3. DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100%. DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.
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GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

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PARTS LIST

THERMONICS

HEATER ASSY. HOT
2420

J LYLES 7/28/77

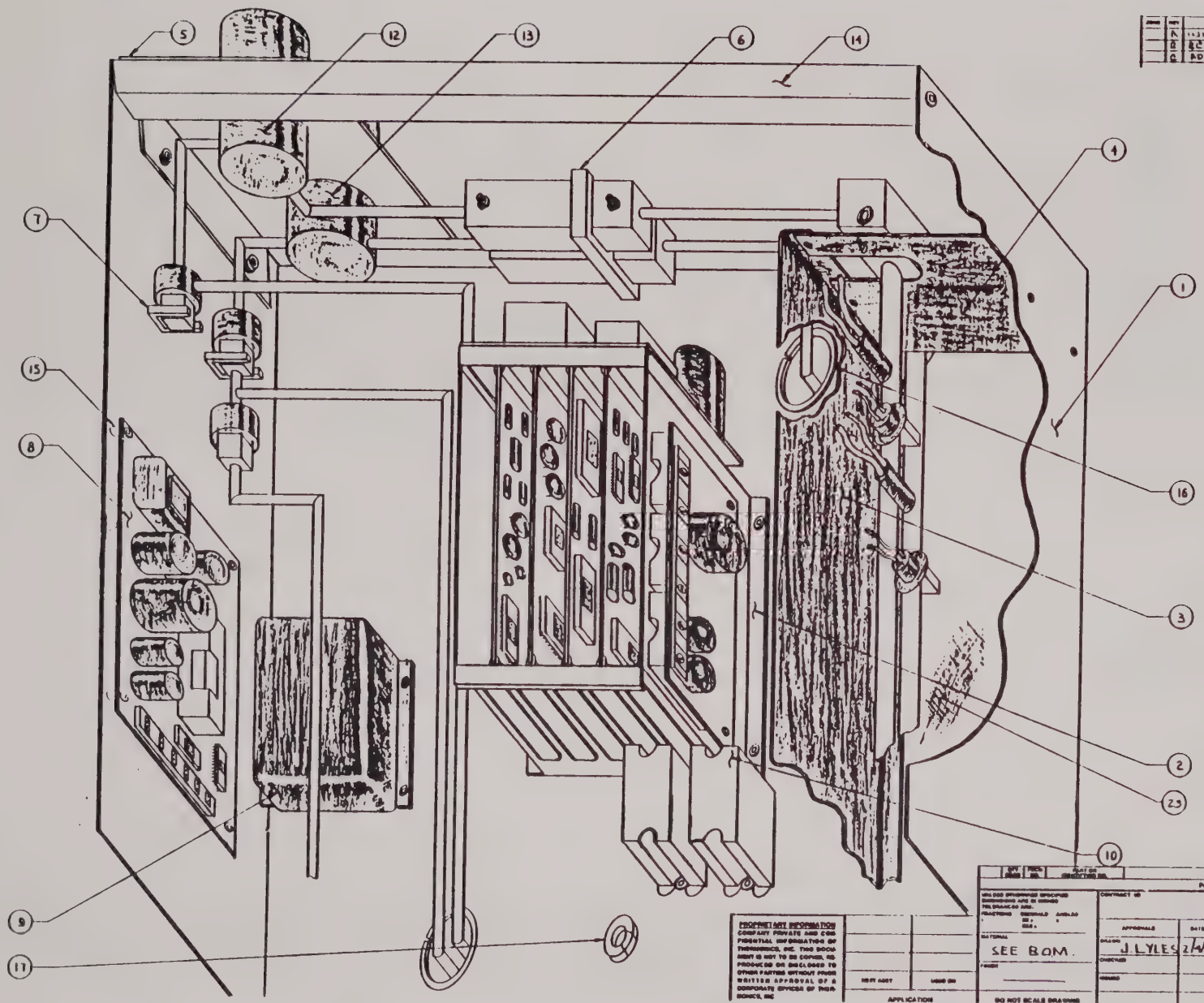
SIZE D | DWG NO 1R-114-1A | REV D

SCALE 1:1 WEIGHT

PART LIST 1R-117-1A

CHASSIS ASSEMBLY, T-2420

REFERENCE	PART NUMBER	DESCRIPTION
1	1R-070-1D	CHASSIS
2	1R-118-1A	CARD CAGE ASSEMBLY
3	1R-104-1D	WALL, INSULATING PARTITION
4	1R-103-1D	CAP, INSULATION PARTITION
5	1R-094-1D	BRACKET, REGULATOR
6	1R-065-1D	BRACKET, VENTURI
7	1R-085-1D	BRACKET, SUPPORT
8	B6-001	POWER SUPPLY, SWITCHING
9	B7-001	FILTER, EMI LINE, 20A
10	X1-034	SWITCH, AROMAT, RELAY
11	B2-010	TRANSFORMER, ELECTROMECH
12	1R-114-1A	HEATER ASSEMBLY, HOT
13	1R-115-1A	HEATER ASSEMBLY, COLD
14	1R-093-1D	BAR, SPACER
15	H3-097	STANDOFF, MALE/FEMALE
16	R2-007	GROMMET, CONTINUOUS, POLY
17	W1-071	BUSHING, NYLON INSULATING
18	H2-079	SCREW, BHCS, S/S, 6-32 X 1/4
19	H2-229	SCREW, BHCS, S/S, 6-32 X 1/2
20	H2-026	SCREW, BHCS, S/S, 6-32 X 3/8
21	H2-067	SCREW, BHCS, S/S, 4-40 X 1/4
22	H2-022	SCREW, BHCS, S/S, 6-32 X 3/8
23	I1-010	CERAWOOL, BULK FIBERS
24	B2-004	TRANSFORMER, 50 WATT



	A	INITIAL RELEASE (ECO 166-1	
	B	REVISED ITEM (1)	
	C	ADD INSULATION ITEM 52	

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MONICS, INC

SEE BOM.

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THERMONICS

CHASSIS ASSY. 2420

D

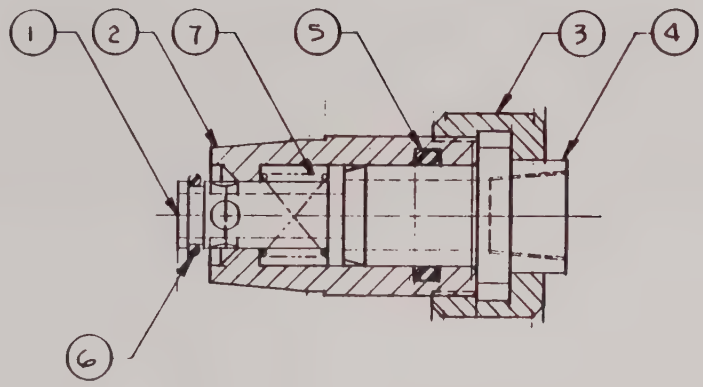
12-117-1A

PART LIST 1R-149-1A

VALVE ASSEMBLY

REFERENCE	PART NUMBER	DESCRIPTION
1	1R-150-1D	SPOOL
2	1R-151-1D	BODY VALVE
5	R1-029	O-RING, SILICON RUBBER
6	R1-028	O-RING, SILICON RUBBER
7	H1-042	SPRING, .047 OD, .480 DIAMETER

ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	INITIAL RELEASE ECN #1531	1/14/85	



3 DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100% DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.

2. SURFACE FINISH 125 MIN. UNLESS OTHERWISE SPECIFIED.

1. BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .015 REMOVE RAZOR EDGES ON SHEET METAL PARTS.

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

QTY REQD	FSCM NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION
			PARTS LIST	

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS ±1/64 DECIMALS .X ± .01 .XX ± .005 ANGLES ±1°

CONTRACT NO

MATERIAL

FINISH

PTFS 2420

NEXT ASSY | USED ON

APPROVALS	DATE
DRAWN RL	1/14/85
CHECKED	
ISSUED	

THERMONICS

VALVE ASSEMBLY

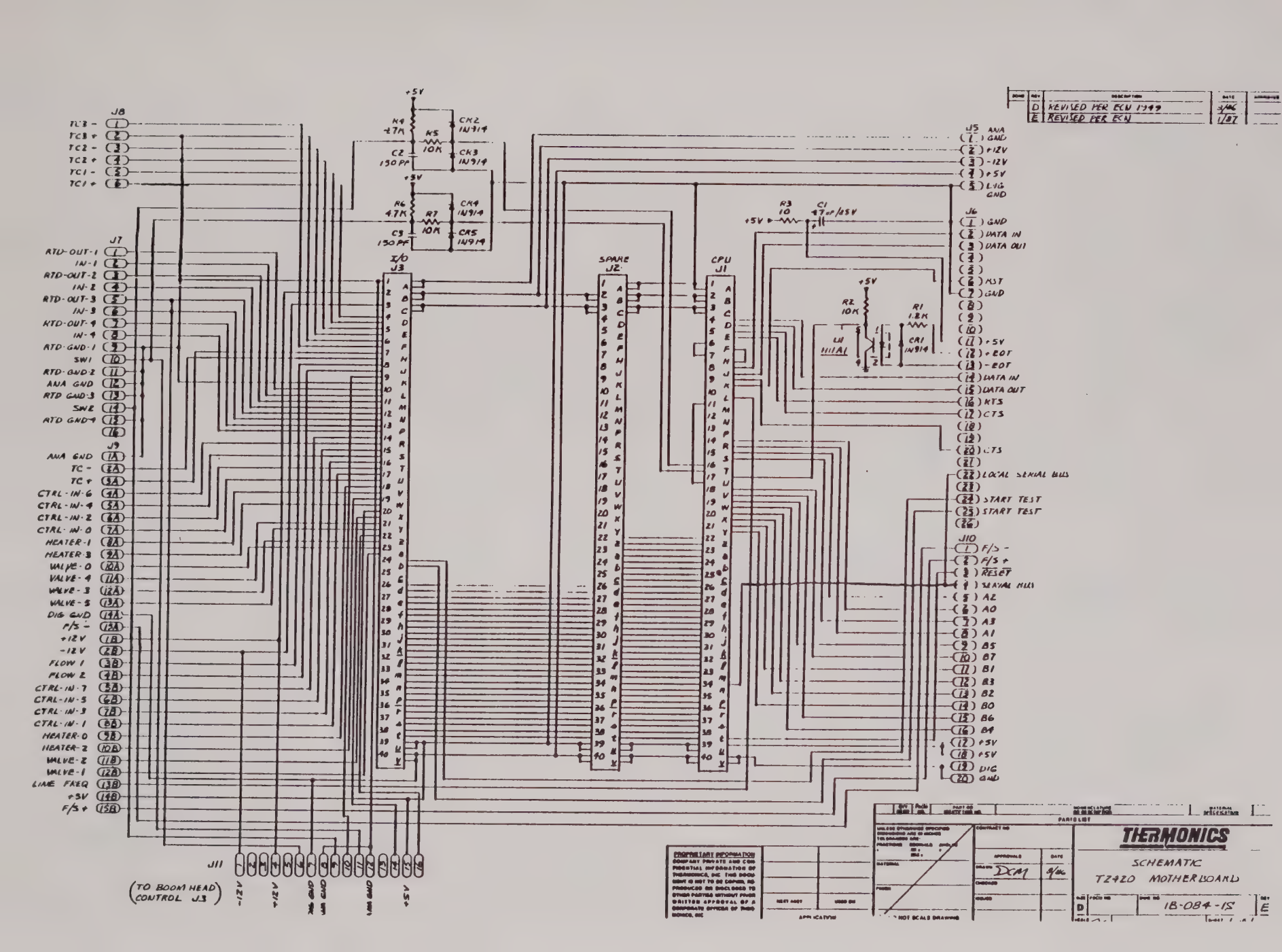
SIZE	FSCM NO.	DWG NO	REV
C		1B-149-1A	A

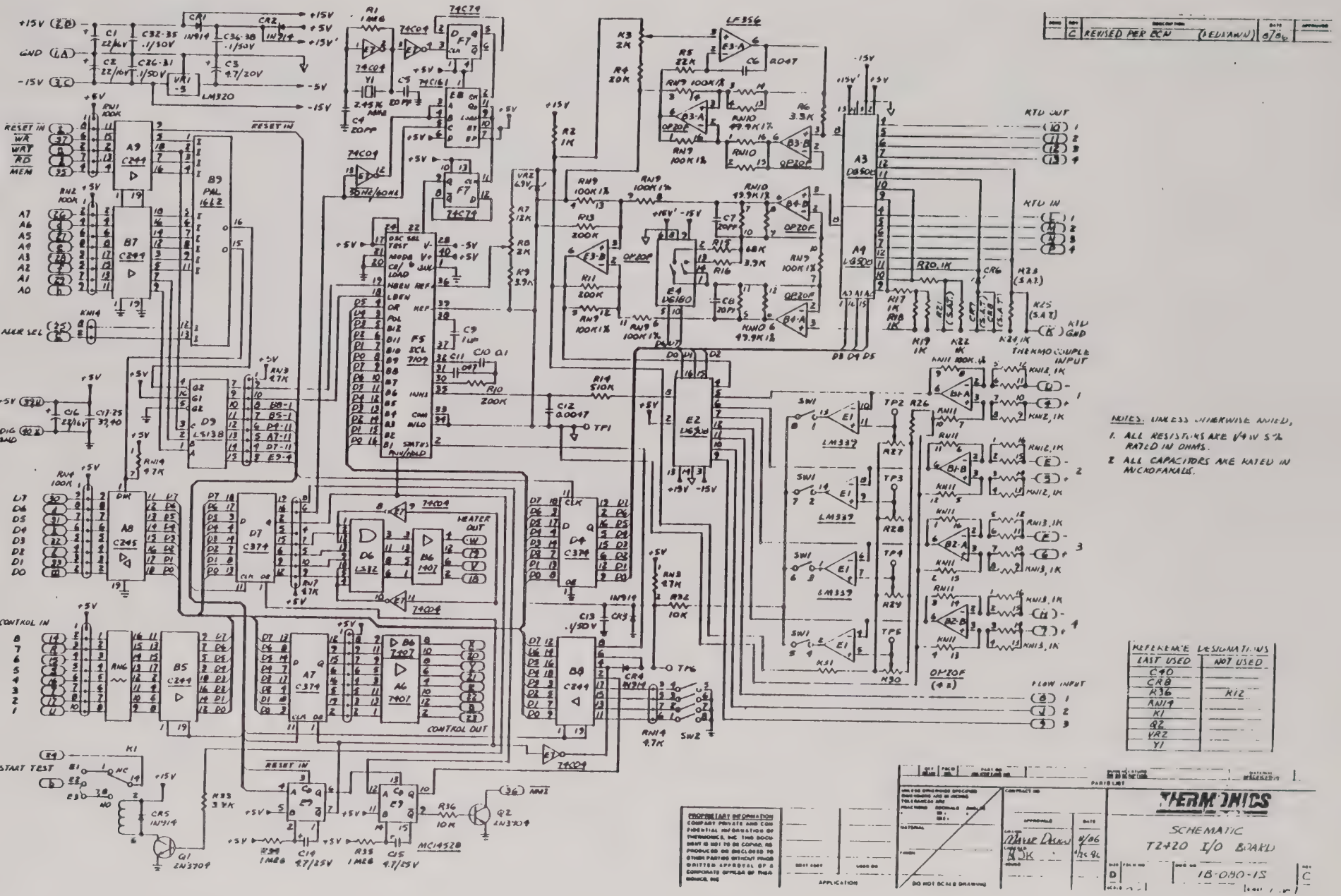
SCALE 2/1 | SHEET 1 OF 1

PART LIST 1R-111-1A

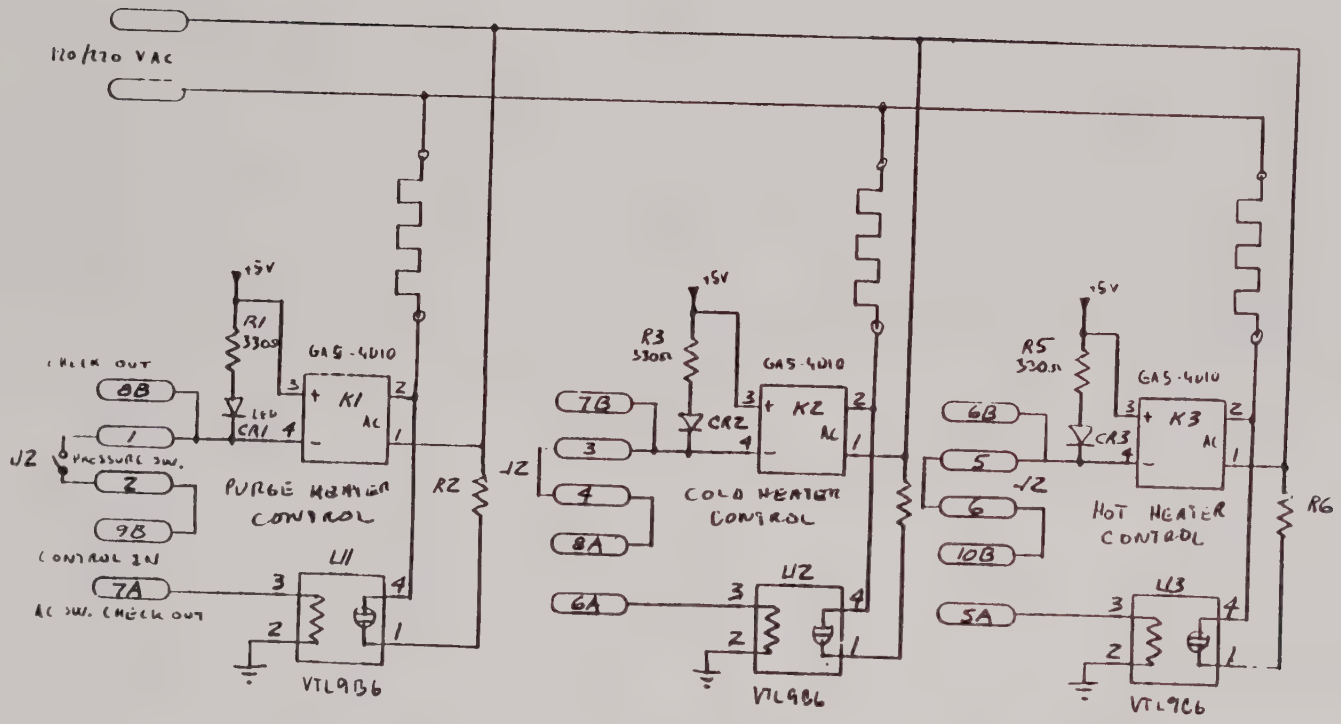
FRONT PANEL ASSEMBLY, T-2420

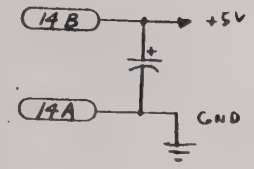
REFERENCE	PART NUMBER	DESCRIPTION
1	1R-072-1D	PANEL, FRONT
2	A1-006	DISPLAY, VACUUM FLOURESCENT
3	1B-088-1A	PCB, FRONT PANEL
6	X1-040	SWITCH, ROCKER, RED
7	H2-072	SCREW, S/S, 4-40
8	C1-101	HOUSING, TERMINAL
9	C1-102	TERMINAL, CRIMP
10	W1-033	CABLE, FLAT
13	H2-210	SCREW, S/S, 6-32 X 3/8
14	C1-009	CONNECTOR, 16 PIN, FLAT
15	W1-069	CABLE, FLAT, 16 CONDUCTOR
16	C1-171	CONNECTOR, 20 PIN, FLAT
17	C1-145	CONNECTOR, 20 PIN, FLAT


J8
TC3 -
TC3 +
TC2 -
TC2 +
TC1 -
TC1 +
J7
RTD-OUT-1
IN-1
RTD-OUT-2
IN-2
RTD-OUT-3
IN-3
RTD-OUT-4
IN-4
RTD-GND-1
SW1
RTD-GND-2
ANA GND
RTD GND-3
SW2
RTD GND-4
J9
ANA GND
TC -
TC +
CTRL-IN-6
CTRL-IN-4
CTRL-IN-2
CTRL-IN-0
HEATER-1
HEATER-3
VALVE-0
VALVE-4
VALVE-3
VALVE-5
DIG GND
F/S -
+12V
-12V
FLOW 1
FLOW 2
CTRL-IN-7
CTRL-IN-5
CTRL-IN-3
CTRL-IN-1
HEATER-0
HEATER-2
VALVE-2
VALVE-1
LINE FREQ
+5V
F/S +
+5V
R4 47K
R5 10K
C2 150 PF
CR2 IN914
CR3 IN914
R6 47K
R7 10K
C3 150 PF
CR4 IN914
CR5 IN914
I/O J3
SPARE J2
CPU J1
R3 10
C1 47 uF/25V
R2 10K
R1 1.2K
U1 1111AL
CR1 IN914
J5 ANA
GND
+12V
-12V
+5V
LOG GND
J6
GND
DATA IN
DATA OUT
RST
GND
+5V
+EOT
-EOT
DATA IN
DATA OUT
RTS
CTS
CTS
LOCAL SERIAL BUS
START TEST
START TEST
J10
F/S -
F/S +
RESET
SERIAL BUS
A2
A0
A3
A1
B5
B7
B1
B3
B2
B0
B6
B4
+5V
+5V
DIG GND
J11
(TO BOOM HEAD CONTROL J3)
-12V
+12V
DIG GND
ANA GND
LINE GND
+5V
D REVISED PER ECN 1949 3/DEC 1/87
E REVISED PER ECN
PROPRIETARY INFORMATION
THERMONICS
SCHEMATIC
TZ420 MOTHERBOARD
IB-084-1S
D
E


REVISED PER ECN (DELRAWN) 9/84
NOTES: UNLESS OTHERWISE NOTED,
1. ALL RESISTANCES ARE 1/4 W 5% RATED IN OHMS.
2 ALL CAPACITORS ARE RATED IN MICROFARADS.
REFERENCE DESIGNATIONS
LAST USED
NOT USED
C40
CR8
R36
R12
RN19
K1
Q2
VR2
Y1
THERMONICS
SCHEMATIC
T2420 I/O BOARD
18-0010-1S
PROPRIETARY INFORMATION
DO NOT SCALE DRAWING

REVISIONS				
REV	DESCRIPTION		DATE	APPROVED
A	INITIAL REL	1469	12-5-84	





QTY REQD	CODE IDENT	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION
			PARTS LIST	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO

APPROVALS	DATE
DRAWN HDK	5/10/85
CHECKED	
ISSUED	

NEXT ASSY	USED ON
APPLICATION	

THERMONICS

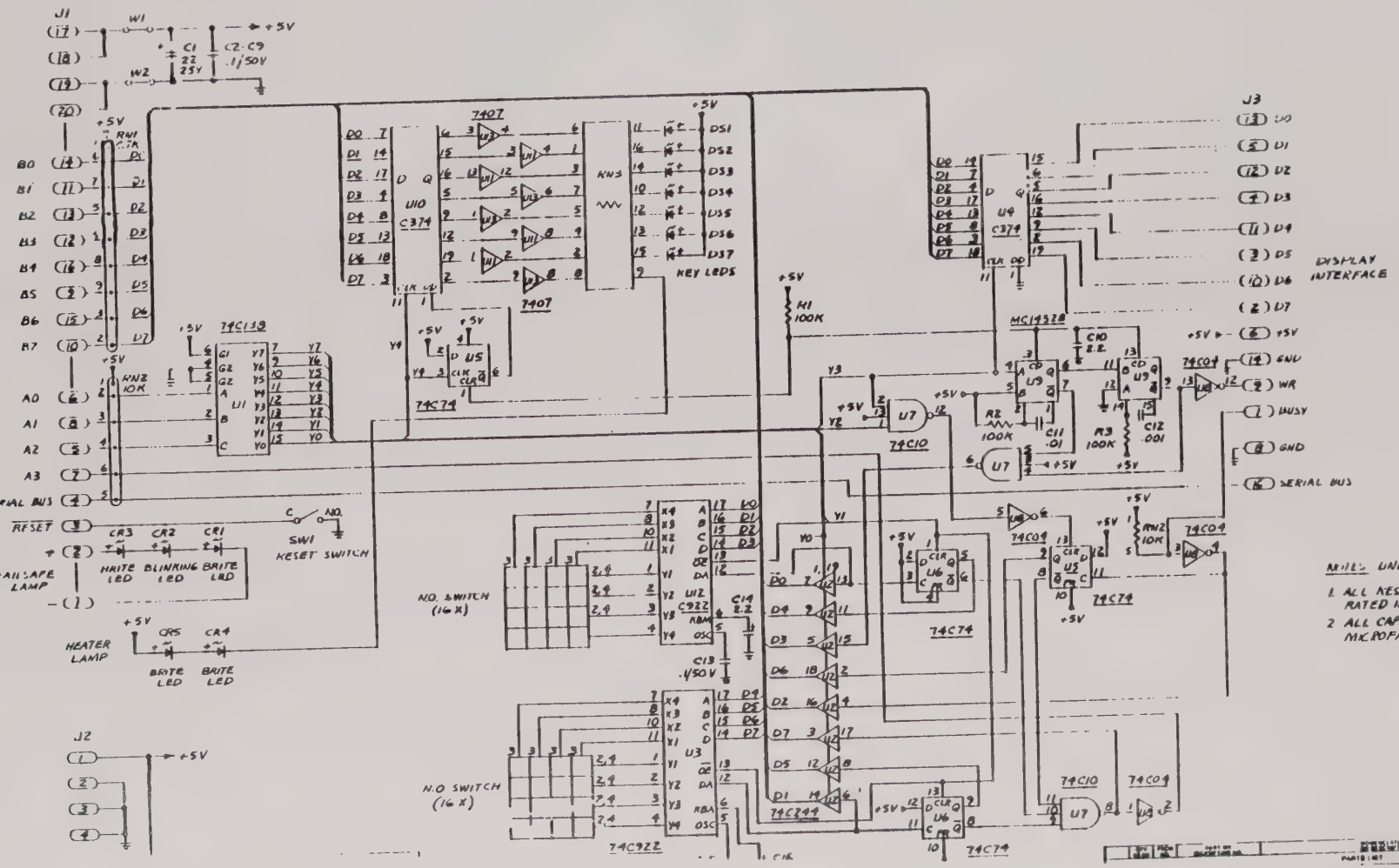
HEATER CONTROL BOARD
T2420K

SIZE	FSCM NO.	DWG. NO.	REV
B		1B-087-1S	A

SCALE

SHEET

	C	REVISED PER ECN 1992	8/86



NOTES: UNLESS OTHERWISE SPECIFIED,

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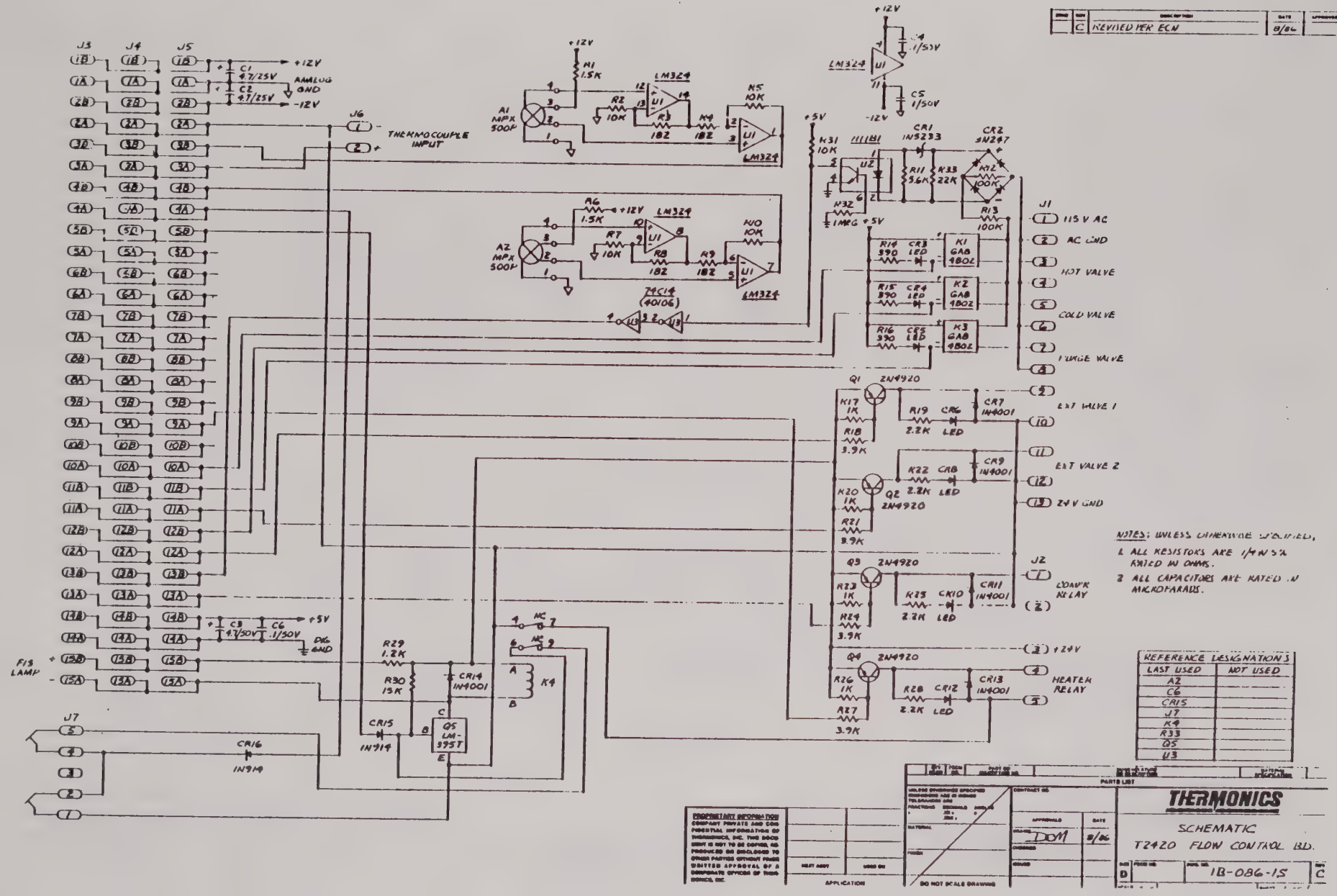
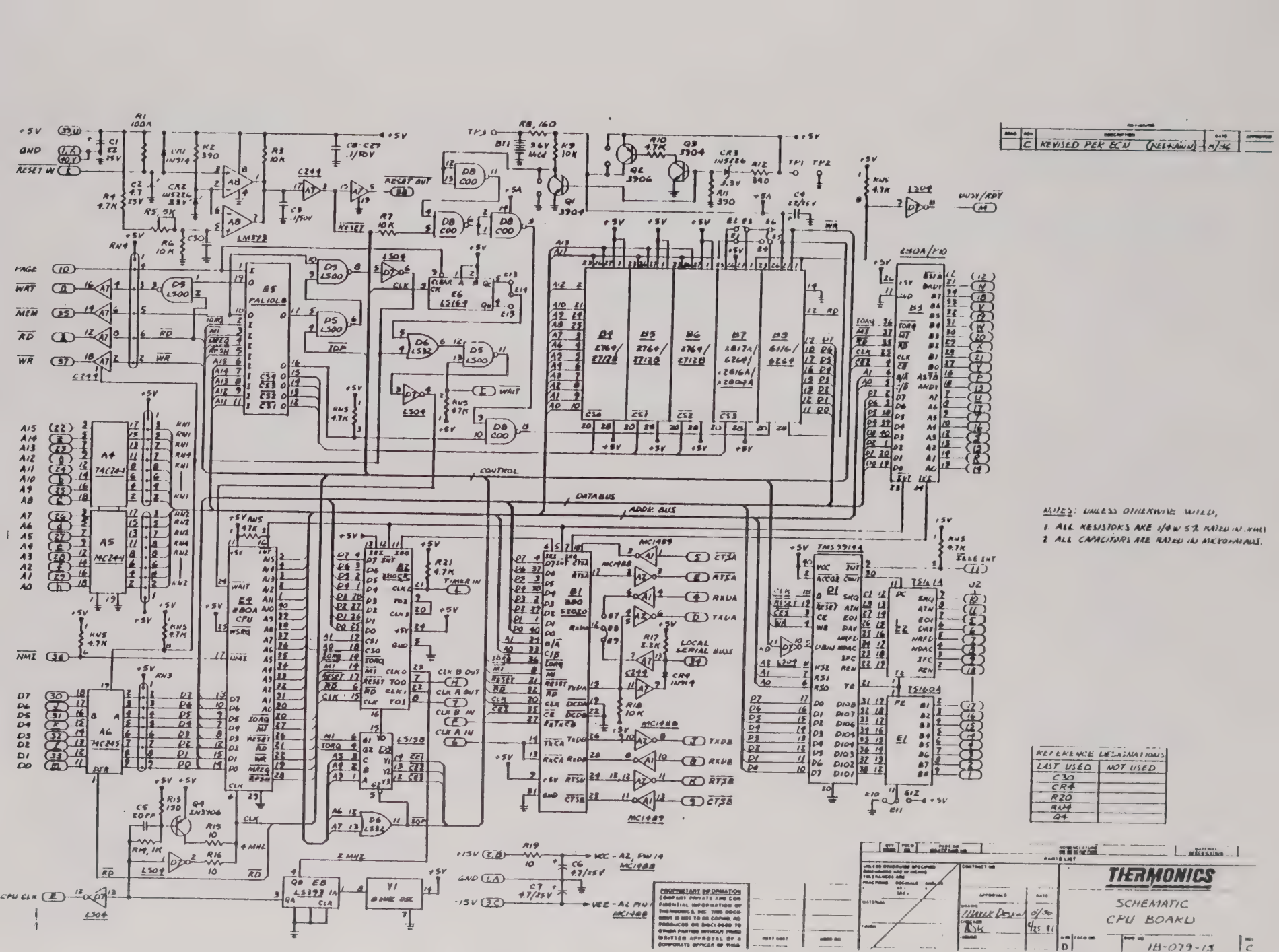
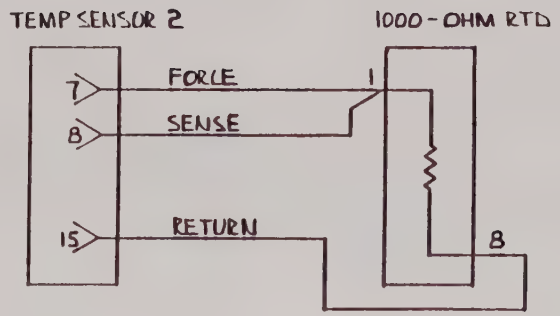
2. ALL CAPACITORS ARE RATED IN MICROFARADS.


C REVISED PER ECN 8/86
J3 J4 J5
+12V
C1 4.7/25V
C2 4.7/25V
ANALOG GND
-12V
J6
THERMOCOUPLE INPUT
+12V
R1 1.5K
A1 MPX 500#
LM324
R2 10K
R3 182
R4 182
R5 10K
U1
LM324
+12V
C4 1/50V
LM324
U1
C5 1/50V
-12V
+5V
R31 10K
U2
CR1 1N5233
CR2 1N247
R11 56K
R33 22K
R12 100K
R13 100K
R32 1MEG
+5V
A6 +12V 1.5K
A2 MPX 500#
LM324
R7 10K
R8 182
R9 182
R10 10K
U1
LM324
74C14 (4010G)
U3
J1
1 115 V AC
2 AC GND
3 HOT VALVE
4
5 COLD VALVE
6
7 PURGE VALVE
8
R14 390 CR3 LED K1 GAB 1B0Z
R15 390 CR4 LED K2 GAB 1B0Z
R16 390 CR5 LED K3 GAB 1B0Z
Q1 2N4920
R17 1K
R18 3.9K
R19 2.2K
CR6 LED
CR7 IN4001
9 EXT VALVE 1
10
R22 2.2K
CR8 LED
CR9 IN4001
11 EXT VALVE 2
12
Q2 2N4920
R20 1K
R21 3.9K
13 24V GND
Q3 2N4920
R23 1K
R24 3.9K
R25 2.2K
CR10 LED
CR11 IN4001
J2
1 LOADER RELAY
2
3 +24V
Q4 2N4920
R26 1K
R27 3.9K
R28 2.2K
CR12 LED
CR13 IN4001
4 HEATER RELAY
5
NOTES: UNLESS OTHERWISE SPECIFIED,
1. ALL RESISTORS ARE 1/4W 5% RATED IN OHMS.
2. ALL CAPACITORS ARE RATED IN MICROFARADS.
REFERENCE DESIGNATIONS
LAST USED / NOT USED
A2
C6
CR15
J7
K4
R33
Q5
U3
C3 4.7/50V
C6 .1/50V
+5V
DIG GND
FIS LAMP
R29 1.2K
R30 15K
CR14 IN4001
K4
MC
MC
A
B
CR15 IN914
CR16 IN914
Q5 LM-395T
C
B
E
J7
5
4
3
2
1
CONFIDENTIAL INFORMATION
PARTS LIST
DO NOT SCALE DRAWING
APPLICATION
THERMONICS
SCHEMATIC
T2420 FLOW CONTROL BD.
DOM 8/86
1B-086-15
D
C


REVISED PER ECN (NEL+AWN) 4/86
NOTES: UNLESS OTHERWISE NOTED,
1. ALL RESISTORS ARE 1/4 W 5% RATED IN OHMS
2. ALL CAPACITORS ARE RATED IN MICROFARADS.
REFERENCE DESIGNATIONS
LAST USED
NOT USED
C30
CR4
R20
RN4
Q4
PROPRIETARY INFORMATION
THERMONICS
SCHEMATIC
CPU BOARD
IB-079-13
CONTROL
DATA BUS
ADDR. BUS
RESET IN
RESET OUT
WAIT
MEM
RD
WR
NMI
CPU CLK
4 MHZ
2 MHZ
TIMER IN
LOCAL SERIAL BUSS
CLK B OUT
CLK A OUT
CLK B IN
CLK A IN
BUSY/RDY
WAIT
CTSA
RTSA
RXDA
TXDA
TXDB
RXDB
RTSB
CTSB

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	INITIAL RELEASE	11/8/85	



3. DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100%. DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.
2. SURFACE FINISH 125 MIN. UNLESS OTHERWISE SPECIFIED.
1. BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .015. REMOVE RAZOR EDGES ON SHEET METAL PARTS.

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

QTY REQD	FSCM NO	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

PROPRIETARY INFORMATION
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NEXT ASSY | USED ON
APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± 1/64 | DECIMALS .XX ± .01, .XXX ± .005 | ANGLES ± 1/2°

MATERIAL: SEE BOM
FINISH:
DO NOT SCALE DRAWING

CONTRACT NO

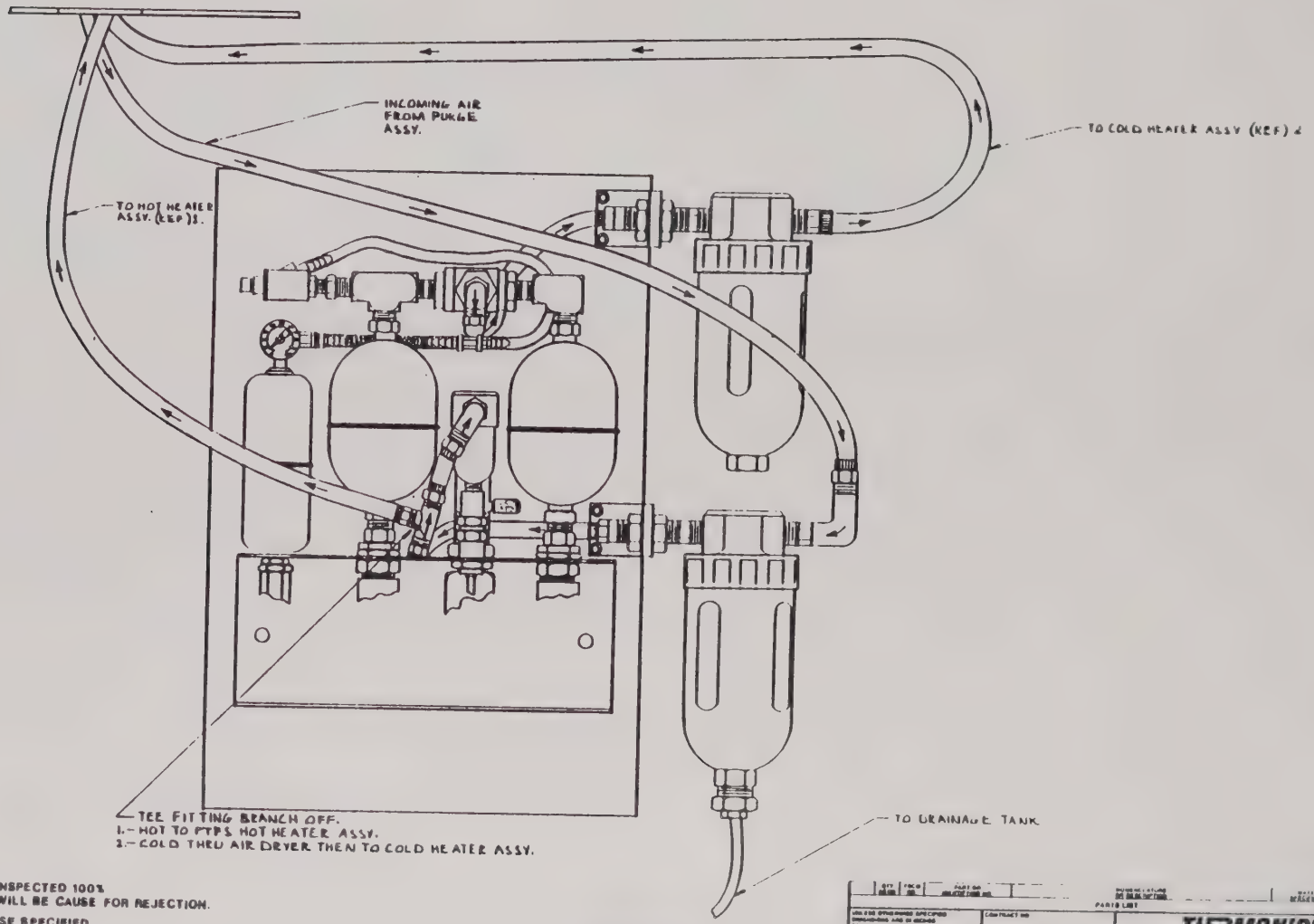
APPROVALS	DATE
DRAWN J.L. YEE	11/8/85
CHECKED	
ISSUED	

THERMONICS

CALIBRATION CONNECTION, DIAGRAM

SIZE	FSCM NO.	DWG NO.	REV
C		IR-173-1W	A

SCALE 1/1 | SHEET 1 of 1


INCOMING AIR FROM PURGE ASSY.
TO COLD HEATER ASSY (REF) 2
TO HOT HEATER ASSY. (REF) 3.
TEE FITTING BRANCH OFF.
1.- HOT TO PTFS HOT HEATER ASSY.
2.- COLD THRU AIR DRYER THEN TO COLD HEATER ASSY.
TO DRAINAGE TANK

3. DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100%. DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.
2. SURFACE FINISH 125 MIN. UNLESS OTHERWISE SPECIFIED.
1. BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .015. REMOVE RAZOR EDGES ON SHEET METAL PARTS.

PROPRIETARY INFORMATION

THERMONICS

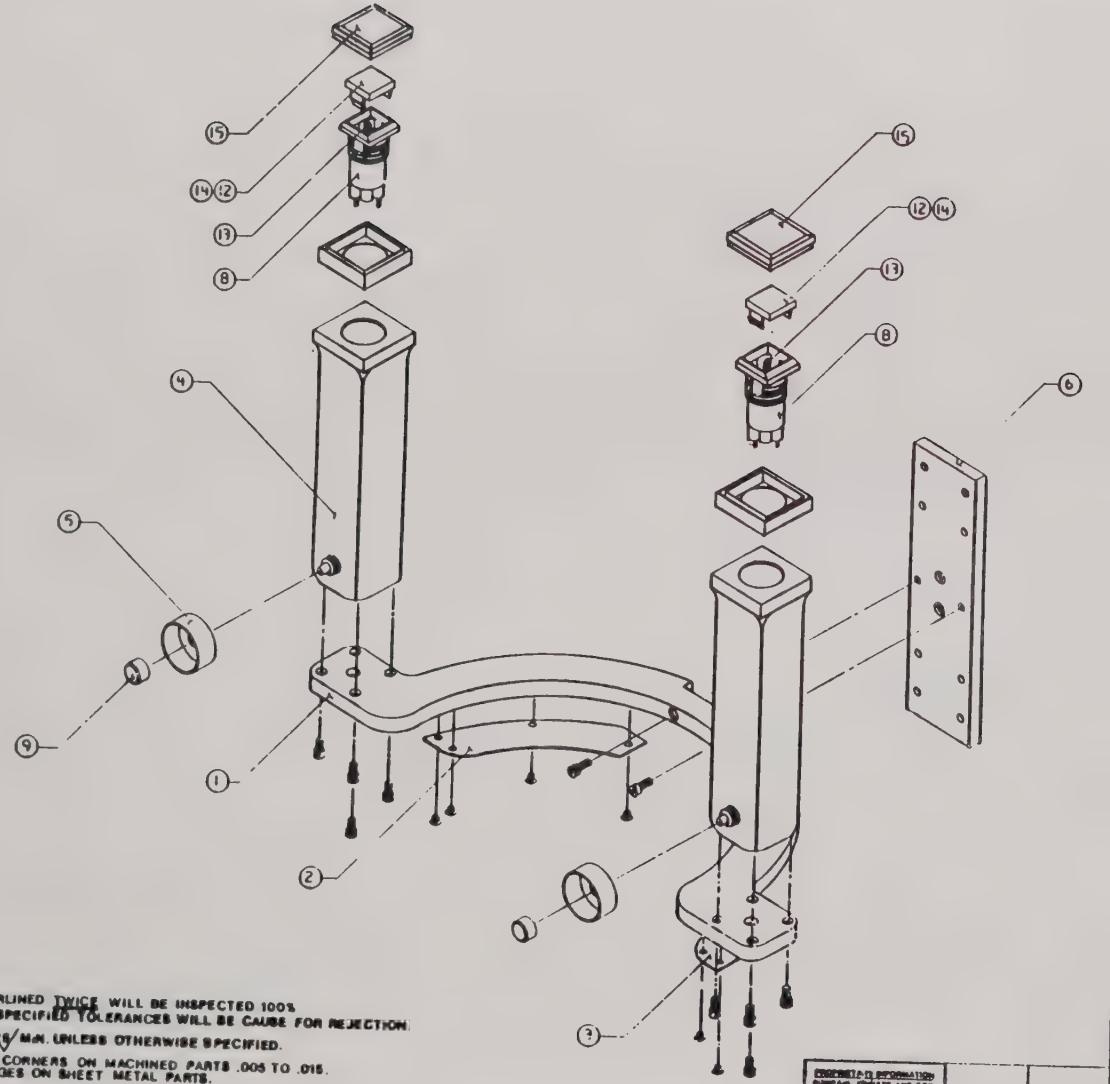
J.LYLES 2-25-10

AIR DRYER TO PTFS PLUMBING DIA. 2420

WIRE DIAGRAM AND SCHEMATIC DRAWING INDEX

1R-154-1P	PLUMBING DIAGRAM, AIR DRYER TO PTFS
1R-173-1W	WIRING DIAGRAM CONNECTION TO PTFS
1B-079-1S	CPU BOARD, SCHEMATIC
1B-080-1S	I/O BOARD, SCHEMATIC
1B-084-1S	MOTHERBOARD WIRING, SCHEMATIC
1B-086-1S	FLOW CONTROL BOARD, SCHEMATIC
1B-087-1S	HEATER CONTROL BOARD, SCHEMATIC
1B-088-1S	PCB, FRONT PANEL, SCHEMATIC

ZONE	REV	DESCRIPTION	DATE	APPROVED
ALL	11	ITG MODIFIED	12.8.87	
ALL	4	P.T.P. E.C.N. 1869		



3. DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100%. DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.
2. SURFACE FINISH 125 MIN. UNLESS OTHERWISE SPECIFIED.
1. BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .015. REMOVE RAZOR EDGES ON SHEET METAL PARTS.

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

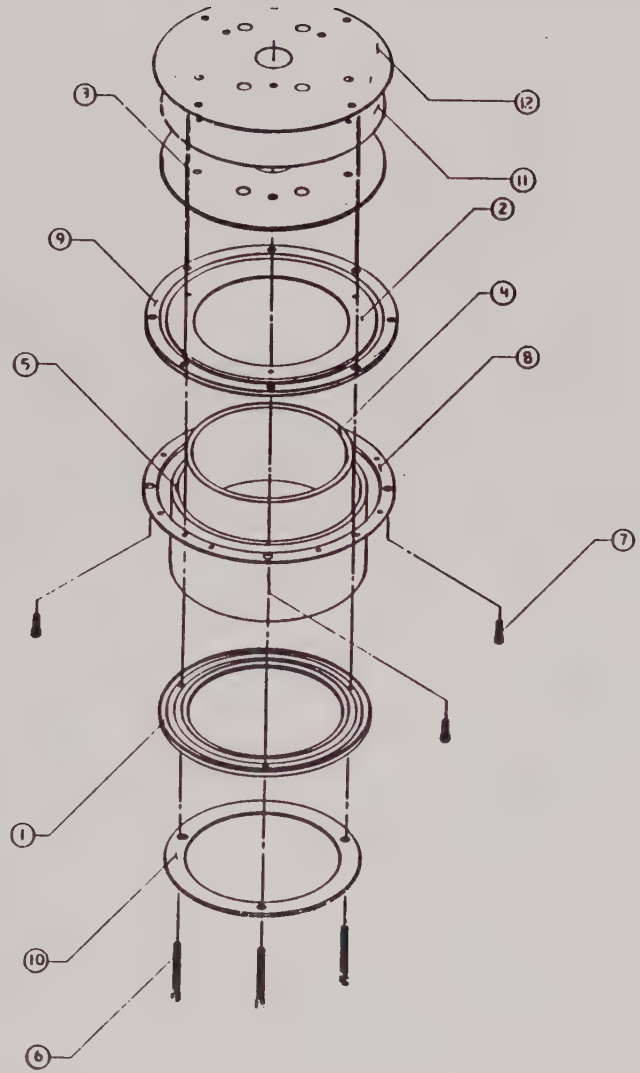
PARTS LIST

APPROVALS	DATE
H. DEP	12.2.87

THERMONICS

HEAD HANDLE ASSEMBLY

REV		DESCRIPTION	DATE	APPROVED
ALL	01	ENG. PROTOTYPE	10-05-87	
ALL	A	PRODUCTION RELEASE - ECN - 1165	11-16-87	



3. DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100%. DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.
2. SURFACE FINISH 125 MIN. UNLESS OTHERWISE SPECIFIED.
1. BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .015. REMOVE RAZOR EDGES ON SHEET METAL PARTS.

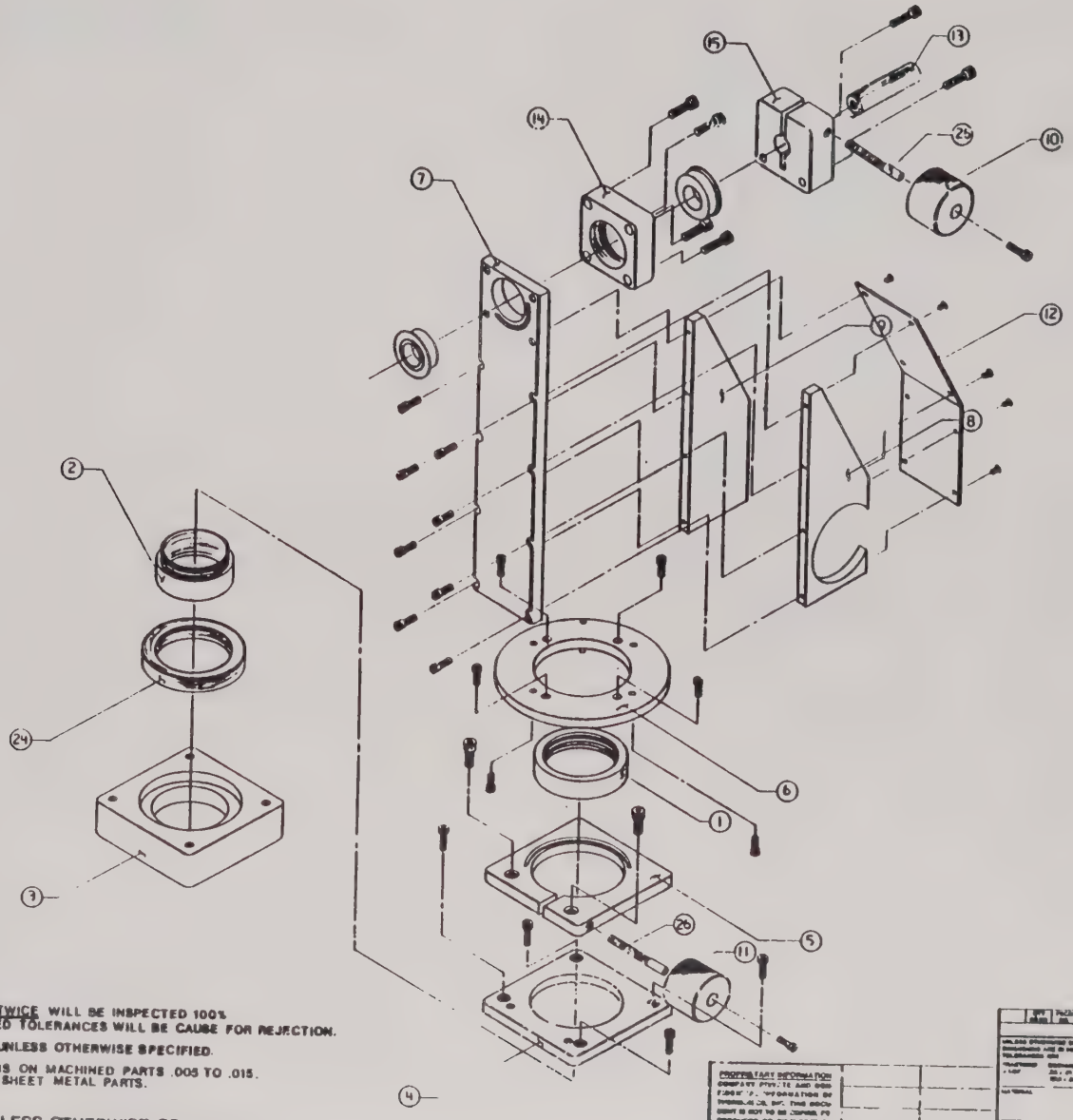
GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

THERMONICS

CUP, ASSEMBLY

SIZE D | 3F-106-1A | REV A1

ALL	01	ENG. PROTOTYPE		
ALL	A	PRODUCTION RELEASE - ECN-1165		



3. DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100%. DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.
2. SURFACE FINISH 125 MIN. UNLESS OTHERWISE SPECIFIED.
1. BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .015. REMOVE RAZOR EDGES ON SHEET METAL PARTS.

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

PROPRIETARY INFORMATION
DO NOT SCALE DRAWING

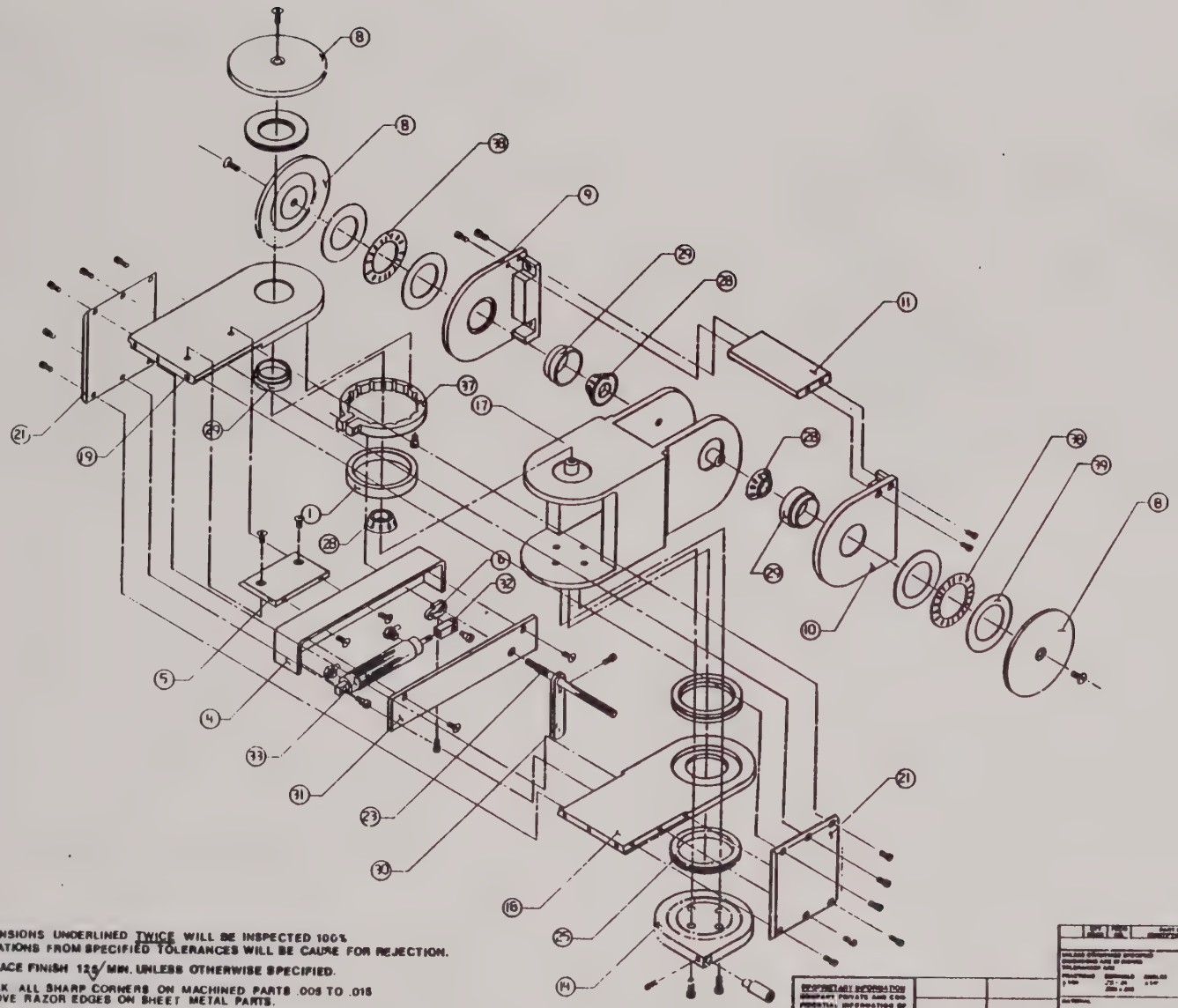
DRAWN	M. DEP	1-14-87	
CHECKED		1-15-87	
APPROVED			

THERMONICS

HEAD BRACKET AND PIVOT ASSY

SIZE	DWG NO	REV
D	3F-104-1A	

SCALE 1/2



REVISIONS				
SHEET	REV	DESCRIPTION	DATE	APPROVED
ALL	01	ENG. PROTOTYPE	1-3-87	
ALL	A	PRODUCTION RELEASE - ECN-1963	1-13-87	

3. DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100%. DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.
2. SURFACE FINISH 125 MIN. UNLESS OTHERWISE SPECIFIED.
1. BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .015 REMOVE RAZOR EDGES ON SHEET METAL PARTS.

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

PROPRIETARY INFORMATION
SUBMIT PRIVATE AND CON-
FIDENTIAL INFORMATION OF
THERMONICS, INC. TO DOOR
RIGHT IS NOT TO BE DISCLOSED, RE-
PRODUCED OR USED FOR
OTHER PURPOSES WITHOUT PRIOR
WRITTEN APPROVAL OF A
CORPORATE OFFICER OF THER-
MONICS, INC.

NEXT ASSY	USED ON	BF-100-A6	
APPLICATION		DO NOT SCALE DRAWING	

PARTS LIST

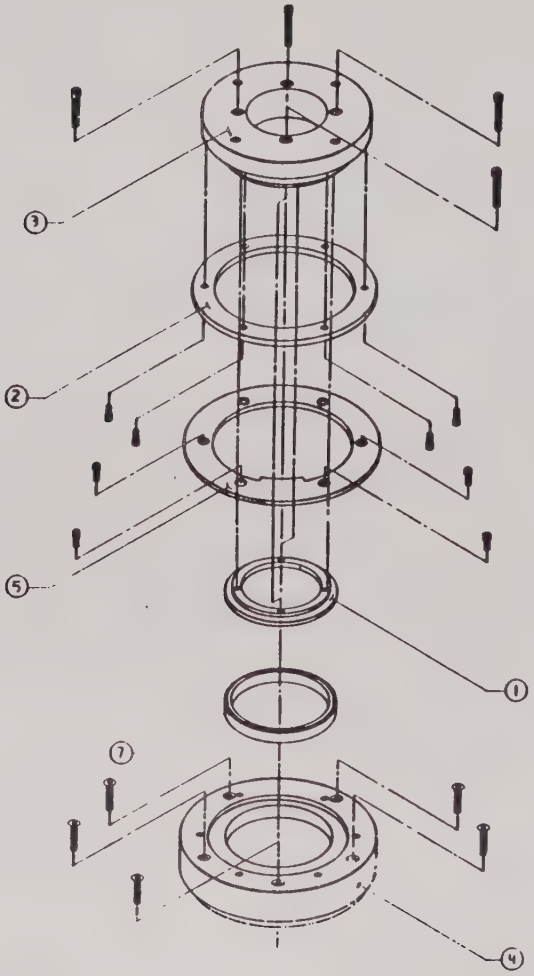
CONTRACT NO.	
APPROVALS	DATE
M. CRIPP	1-09-87
	1-15-87
	1-15-87

THERMONICS

ELBOW AND BRAKE ASSY.

SIZE	FSCM NO.	DWG. NO.	REV
D		BF-103-1A	A1

ALL	01	ETM PROTOTYPE	1-8-87	
ALL	A	PRODUCTION RELEASE - ECN-1966	1-15-87	



3. DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100%. DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.
2. SURFACE FINISH 125 MIN. UNLESS OTHERWISE SPECIFIED.
1. BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .015. REMOVE RAZOR EDGES ON SHEET METAL PARTS.

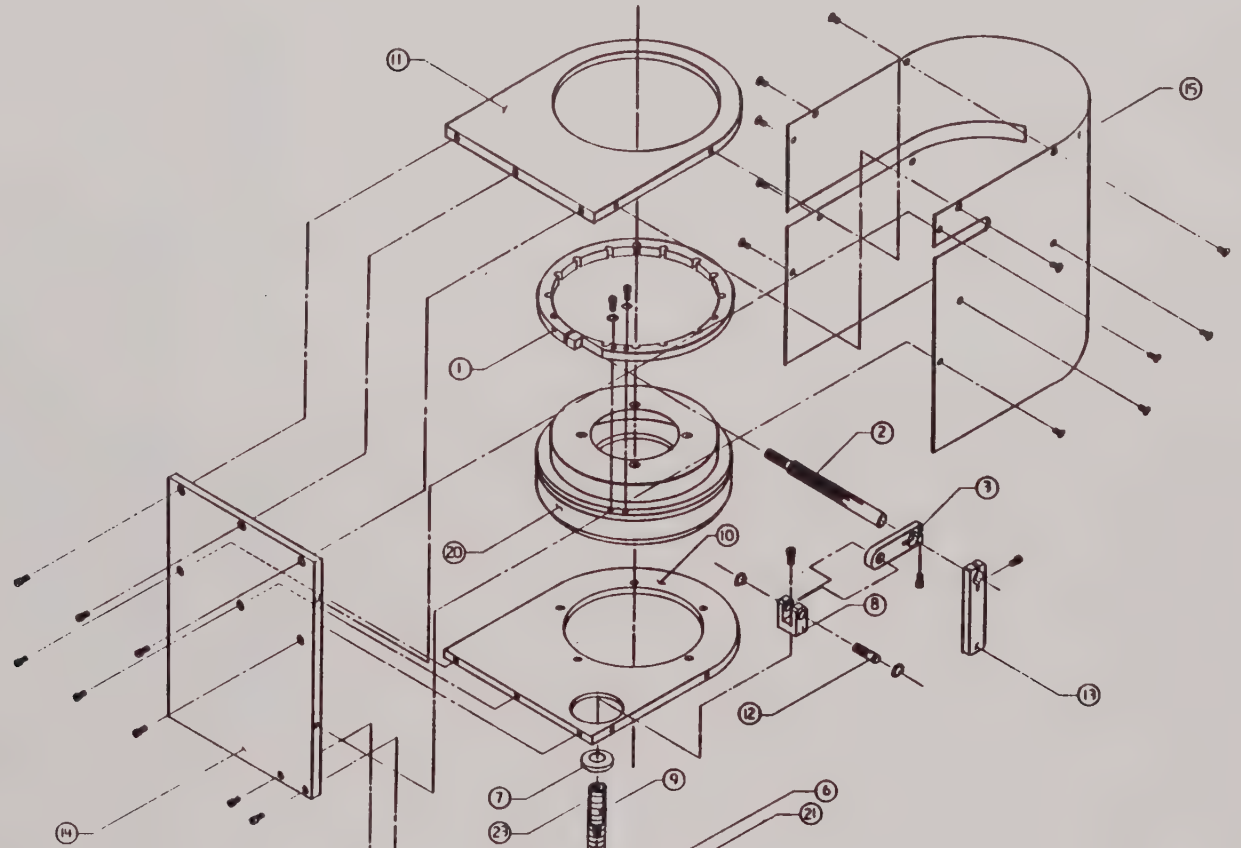
GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

THERMONICS

REAR PIVOT ASSY

D | 3F-102-1A

DWG	REV	DESCRIPTION	DATE	APPROVED
ALL	U	MFG. RELEASE	01-08-87	
ALL	X	PRODUCTION RELEASE - ECN-1065	01-15-87	



DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100%
DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION.

SURFACE FINISH 125 MIN. UNLESS OTHERWISE SPECIFIED.

BREAK ALL SHARP CORNERS ON MACHINED PARTS .005 TO .015.
REMOVE RAZOR EDGES ON SHEET METAL PARTS.

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

PROPRIETARY INFORMATION
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PARTS LIST

CONTRACT NO

APPROVALS	DATE
M.DEP	1-9-87
RGL	1-15-87

THERMONICS

REAR, PIVOT BRAKE ASSY.

PART LIST 1R-210-1A

THERMOSTAT ASSEMBLY, 350°F

REFERENCE	PART NUMBER	DESCRIPTION
1	T1-023	THERMOSTAT, 350°F
2	C1-003	CONNECTOR, FEMALE
3	C1-002	TERMINAL

PART LIST 1R-208-1A

THERMOCOUPLE ASSEMBLY

REFERENCE	PART NUMBER	DESCRIPTION
1	T1-020	CONNECTOR, THERMOCOUPLE, MALE
2	T1-022	THERMOCOUPLE, K-TYPE

PART LIST 1R-207-1A

THERMOCOUPLE ASSEMBLY

REFERENCE	PART NUMBER	DESCRIPTION
1	T1-019	JACK, MINATURE PANEL
2	T1-021	THERMOCOUPLE, K-TYPE

PART LIST 1R-206-1A

THERMOSTAT ASSEMBLY WITH FEMALE CONNECTOR

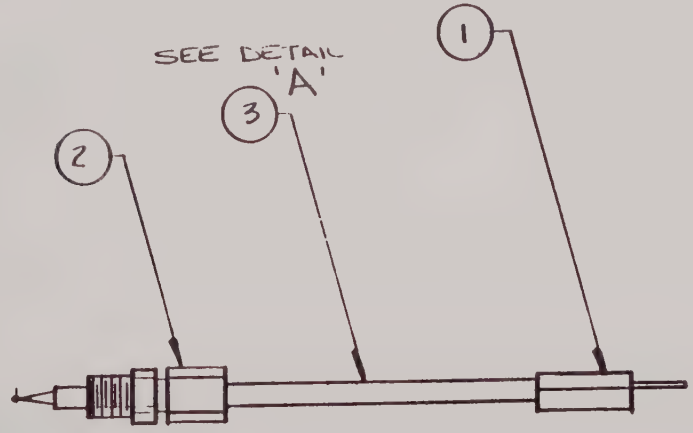
REFERENCE	PART NUMBER	DESCRIPTION
1	T1-013	PLUG, FEMALE, THERMOCOUPLE
2	W1-085	WIRE, THERMOCOUPLE
3	C1-050	LUG, SPADE, RED

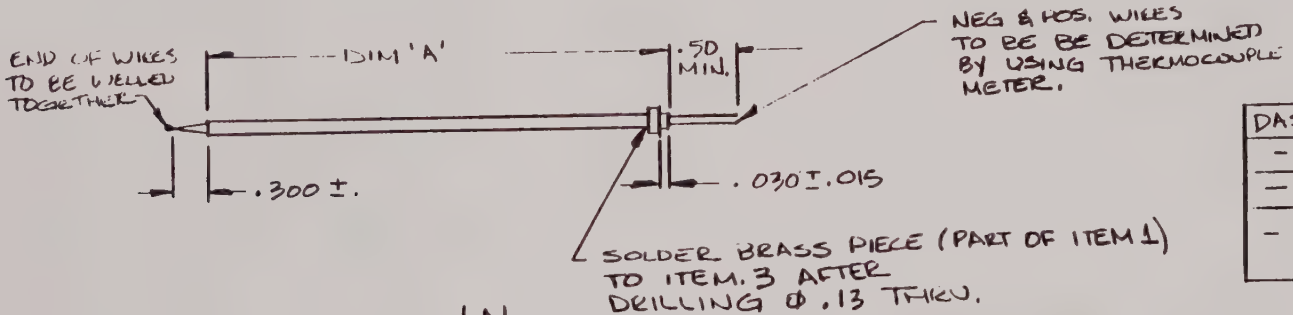
PART LIST 1R-205-1A

THERMOSTAT ASSEMBLY

REFERENCE	PART NUMBER	DESCRIPTION
1	T1-006	THERMOSTAT, SELE, 160 DEG, OPEN
2	C1-003	CONNECTOR, 2 PIN, RECEPTACLE
3	C1-002	TERMINAL, .062 FEMALE
4	W1-007	WIRE, TEFLON, 22 GA, WHITE
5	W1-040	TUBING, SHRINK, 1/8"

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
A	PRODUCTION RELEASE	1/19/07	




END OF WIRES TO BE WELDED TOGETHER
DIM 'A'
.50 MIN.
NEG & POS. WIRES TO BE BE DETERMINED BY USING THERMOCOUPLE METER.
.300 ±.
.030 ± .015
SOLDER BRASS PIECE (PART OF ITEM 1) TO ITEM 3 AFTER DRILLING Ø .13 THRU.

DETAIL 'A'

DASH #	DIMENSION
-1A	2.10 ±.050
-2A	10.00 ±.050
-3A	2.30 ±.050 OMITED ITEM 2

QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION
			PARTS LIST	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ±1/64 DECIMALS .XX ± .01 .XXX ± .005 ANGLES ±1/2°

CONTRACT NO

APPROVALS	DATE
DRAWN Skepfall	1/20/07
CHECKED	
ISSUED	

MATERIAL —

FINISH

THERMONICS

THERMOCOUPLE ASSY

SIZE	FSCM NO.	DWG. NO.	REV
B		1P-1[illegible]-XA	A

3F-100-1A	3F-105-1A	

PROPRIETARY INFORMATION
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3 DIMENSIONS UNDERLINED TWICE WILL BE INSPECTED 100% DEVIATIONS FROM SPECIFIED TOLERANCES WILL BE CAUSE FOR REJECTION
3 SURFACE FINISH 125 [illegible] UNLESS OTHERWISE SPECIFIED

PART LIST 1R-156-1A

THERMOCOUPLE ASSEMBLY

REFERENCE	PART NUMBER	DESCRIPTION
1	T1-020	CONNECTOR, THERMOCOUPLE
2	P2-138	CONNECTOR, MALE, 1/8 OD
3	W1-064	WIRE, METAL, THERMOCOUPLE
4	L1-002	SEALANT, PIPE THREAD
6	L1-001	SEALANT, RTV

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ALL	B	ADDED CRIL RP9, R30 AND R31	1/20/87	
ALL	C	ADDED R32	7/28/87	
ALL	D	REVISED PER ECN 2085	7/10/88	V.T

REAR BRAKE RELEASE

ELBOW BRAKE RELEASE

BOOM HEAD UP/DOWN CONTROL

COLD DIVERTER VALVE CONTROL

HOT HEATER 1 CONTROL

HOT HEATER 2 CONTROL

115/220 VAC INPUT

COLD HEATER CONTROL

BOOM HEAD THERMOCOUPLE INPUT

COLD JUNCTION COMPENSATION

CONFIGURATION TABLE			
X	J1-1	J1-5	JUMPER
-1	LATCH	MOMENT	J5-2 TO J5-3, J5-6 TO J5-7 J6-1 TO J6-2, J6-5 TO J6-6
-2	MOMENT	MOMENT	J5-2 TO J5-3, J5-6 TO J5-7 J6-2 TO J6-3, J6-6 TO J6-7

J3 3 — 14 NOT USED
J3 5 — 11 NOT USED
J3 7 — 12 J1 SNAPDISK INPUT GND
J3 9 — 13 J1 SNAPDISK INPUT
J3 11 — 15 HEAD UP/DOWN SWITCH INPUT
J3 13 — 16 NOT USED

GENERAL NOTES: (UNLESS OTHERWISE SPECIFIED)

PARTS LIST

CONTRACT NO	NONE	THERMONICS	
DRAWN	DATE	2420 BOOM HEAD CONTROL BOARD	
DESIGNED	KJK 12/02/86		
CHECKED			
ISSUED			
CUSTOMER		SIZE C · FSCM NO N/U · DWG NO 1B-100-XS · REV D	
SCALE		SHEET 1 OF 1	

DO NOT SCALE DRAWING

APPLICATION